Gas Journal

VOL. 293. 110th YEAR. LONDON, FEBRUARY 19, 1958 No. 4936 PRICE 1/6

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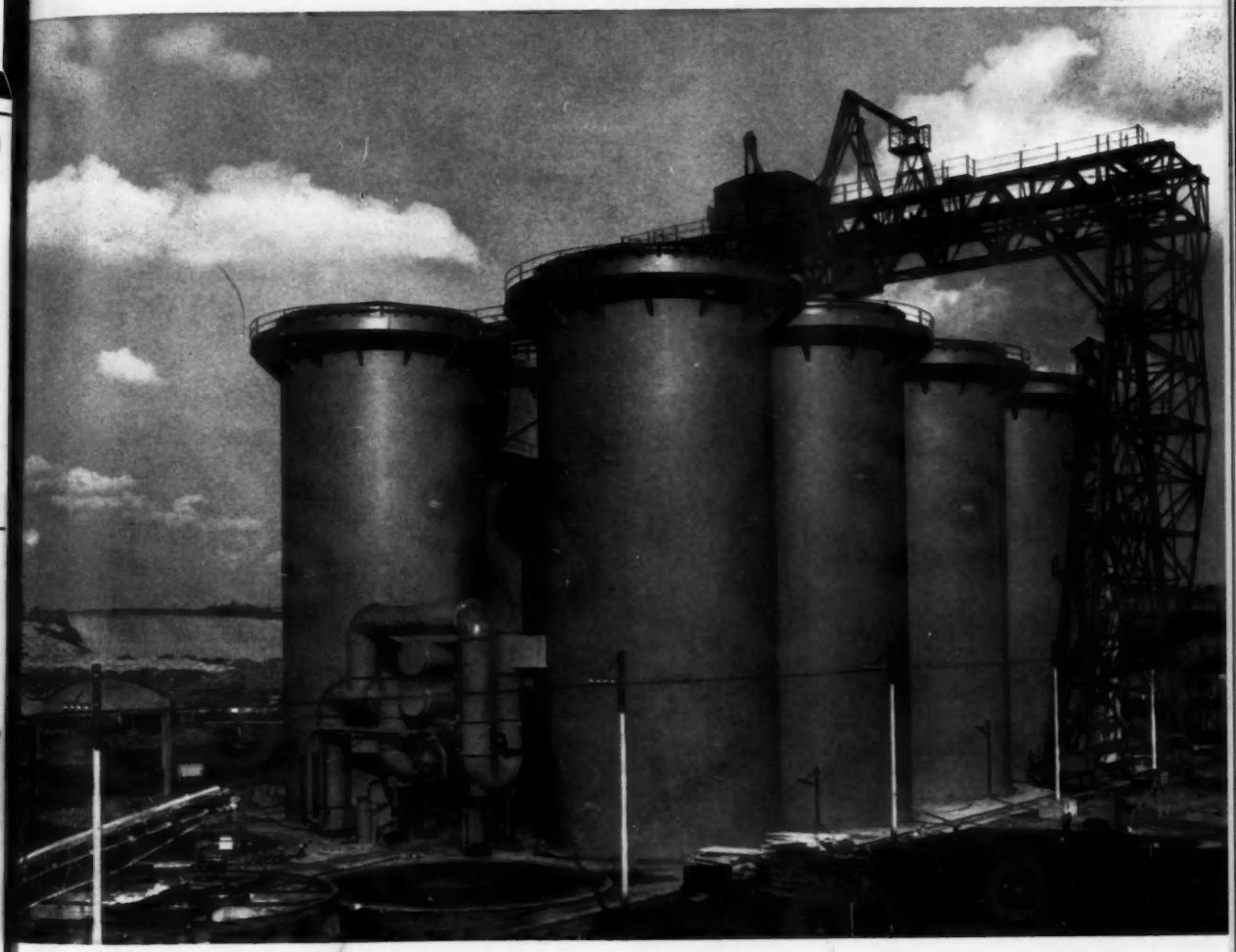
Purification Plant



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...by Holmes

The illustration shows Holmes Tower Purifiers installed at the Manvers Main Coking Plant of the National Coal Board. The plant is at present handling 22 million cu. ft. of gas per day, but is arranged for extension to 32 million cu. ft. per day.

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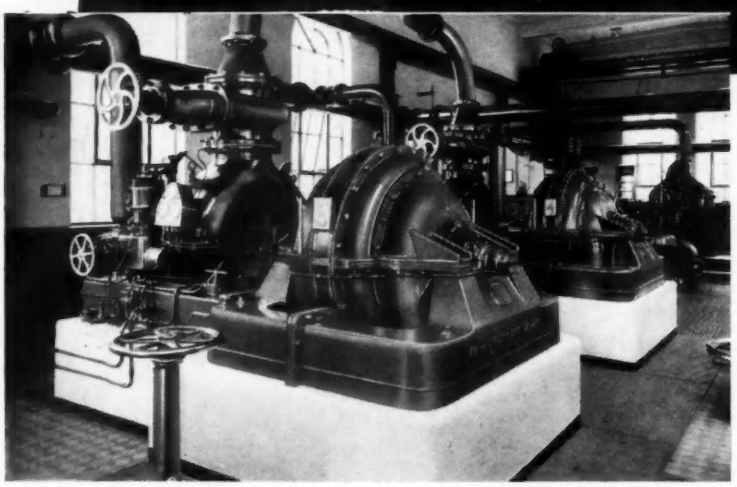

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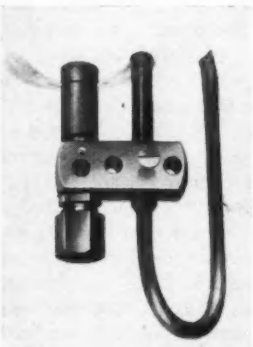

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Gas Journal

VOL. 293 *NO. 4936* *February 19, 1958*

110TH YEAR

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Published by Walter King Limited,
11, Bolt Court, Fleet St., London, E.C.4

Telephone: FLEet Street 2236-7 Telegrams: Gasking, Fleet.

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Gas Journal

VOLUME 293. No. 4936. FEBRUARY 19, 1958. 110th YEAR

Engineers and Management

IN the days when the gas industry was in the hands of private enterprise, the title of Engineer and Manager was given to the chief executive officer of the undertaking.

He was responsible to the board of directors or the municipal gas committee and was there to carry out such policies as these bodies might decide. At heart this officer was probably more of an engineer than a manager but this did not detract from the importance of either aspect of his responsibilities as chief executive.

In the last 30 or 40 years businesses have greatly increased in size, and businessmen have found it necessary to employ subordinates to manage the large staffs that have become necessary, almost independently of the general activity of the firm. This has meant that an independent technique of management has emerged and aspiring executives can become trained in it as in any other profession.

How does the scientist, engineer or technologist fit into the general picture of top management? Are many technically trained men to be found in the top management posts in many of our manufacturing, chemical and technical industries? We are led to believe that it is the exception rather than the rule, especially among the boards of directors. It should be everyone's ambition, when he joins his firm as a young man, to rise to the highest positions in the firm and to qualify for a seat on the board. This should be possible for anyone whatever his basic training may have been. It should make no difference if he was trained as a scientist or engineer or lawyer or accountant or economist. Members of all these professions could fill a very necessary function on any firm's board. Needless to say, when a member of a board is a full-time executive director, he is very likely to be in charge of some department in which his specialist knowledge will have full scope and where full use can be made of his experience in his own particular field.

It would seem that the presence of a technically trained man on the board would be of considerable assistance to a large firm dependent on exploiting the very latest ideas and the most modern techniques for manufacture of highly technical products in a very competitive market. If the directors consist of administrators, accountants and financial men only, it would seem possible that some time a problem might have to be faced which could not be solved by the directors themselves without first calling in either the firm's own technical specialists or an outside firm of consultants. If the problem had been resolved by a member of the board, it would have saved time and possibly would have been a better and more satisfactory solution. The presence of someone with a trained scientific or engineering brain at all meetings of the board might, in regular discussion with his fellow directors, have prevented any problem of this kind ever arising in the first place. The invention and development of electronic computers and the extension of mathematical statistics to industry has done much to rationalise the forecasting of trends. It is no longer necessary to have such great commercial experience of the past history of the world's markets at easy call. The mathematician can reduce much of this to formulæ and can solve the equations electronically; he too can calculate the more economical use of certain techniques and save costs in administration by the scientific channelling of information. There still remains, however, the need for men of real ability to interpret these final analyses. If such men are to be found among the firm's directors, so much better for the firm.

Why is the engineer or technologist somewhat rarely found on the boards of large companies? Is it because he is incapable of communicating his ideas? Is he a bad mixer? Or are his intellectual attainments inferior to others with a different background? Such questions are not easily answered. It may be a matter of prejudice but it is undoubtedly felt among some people that the intellectual effort needed for an engineering or scientific degree is not of such a high order as that needed for the classical and philosophical degree at one

of our older universities. The young man who takes up science or engineering has been 'playing with toys' all his life, while the arts man has been reading and absorbing the experience of the past. He has in fact mastered the humanities and will be able to direct and manage his fellow creatures.

Both types of trained mind are needed in industry today and, indeed, if they are of equal calibre and brilliance, both are of an equal order of ability. If these two types of person can work together—and they should be able to do so—if each is recognised as complementary to the other, then industry in this country need have no fears of a decline in the foreseeable future. It will have the best direction and the best brains will be attracted to it.

It is instructive to look at the way in which large firms are interesting themselves in the education of young men and women entering industry. Many firms, including the nationalised industries, are running courses of training for apprentices and for those entering industry from secondary and public schools, but it is more uncommon to find courses for university graduates, for their training to the most important posts. The best examples of firms doing this are the oil companies, which realise that without the best trained minds they are liable to slip back into second place.

In the gas industry, on the other hand, we think that in the past the influence of the engineer has been too great, and his influence in the Gas Council and his preponderance among chairmen of the area boards is really out of all proportion to the other influences and shades of opinion needed at the highest level of the industry. As the gas industry grows in importance the need to streamline its business methods becomes more and more apparent. Past accounting methods were both clumsy and costly, while the selling and public relations departments were hopelessly inadequate.

In the gas industry the pendulum needs to swing a little further away from the engineering influences, but once the balance has been struck, it should be maintained by the recruiting and training of able men of equal ability but different background who will be ready and willing to steer the industry in the direction it should go.

Gastechnik

THE Gastechnik process of gas purification was originally developed by the Concordia Colliery Co. in Germany in the early 1930s. Robert Dempster and Sons, Ltd., became interested in it and acquired the rights of manufacture in Great Britain and British possessions throughout the world. After the end of the last war, the connection with the German company was renewed.

There are many novel points about this process which are not shared with other systems. As used in England today it consists of units of three towers in series. Each unit is capable of purifying 2 mill. cu.ft. of gas per day with a hydrogen sulphide concentration of 500 grains per cu.ft. A complete installation will be built up of these units in parallel. The purifying material is in the form of a special extruded pellet composed of oxide and a binder. These pellets are easily handled and can be removed from the base of the tower by one man using a mechanically propelled skip.

The towers are not divided into compartments by trays so that there is no necessity to open the towers to remove full trays of spent oxide and replace them with trays of freshly revivified oxide. By means of a gas lock at the base and top of the tower, pellets may be removed and charged at any time without having to isolate the tower from the gas stream. The original tower system had only two towers, one in use and the other, after undergoing revivification, standing by but ready for immediate use. This arrangement was not considered particularly suitable for conditions in the British gas industry since a good deal of labour would be involved in working the process.

Instead, the three tower system working in series was introduced with No. 1 and No. 2 towers in concurrent flow between gas and pellets and No. 3 tower in counter current. In this way, new or extracted pellets are only charged into No. 3 tower from which clean gas passes to the holder, while sulphided pellets containing different quantities of sulphur are taken from No. 3 to No. 2 tower and from No. 2 tower to No. 1 tower. The plant is run so that pellets containing about 30% sulphur are removed from No. 1 tower. These will be taken to the extraction plant in which the sulphur is removed from the pellets by extraction with perchlorethylene. The sulphur is recovered at approximately 98% purity and the solvent and the pellets used again.

The great advantage of the Dempster system of working is the controlled *in situ* revivification of the pellets and the calculated withdrawal of an accurate weight of pellets to maintain the optimum sulphur content of 30%. In this way the minimum of labour is needed to handle the minimum weight of pellets. The extraction plant by which the sulphur can be converted into a directly saleable commodity is one of the great advantages of this process. The site occupied by both towers and extraction plant together with the necessary screening plant, is comparatively small and at the same time no large areas are necessary for storing either new or spent oxide. Pellets arrive at the works in paper bags and can be stored in a shed in the ordinary way.

The purity of the sulphur which is recovered from the extraction plant very naturally influences the price which the sulphur will fetch, but if all dust is removed from the pellets by screening at every stage of their journey through the towers and to the extraction plant, there should be little fear of oxide dust being carried over into the solvent recovery section.

In addition to orders which are being placed by the gas industry—see the news item on p. 381—these purification plants are finding application outside the gas industry and are now being installed by the chemical and dyeing industries, in the latter case to absorb noxious fumes. The arrangement of towers would not be the same as the three tower units just described since intermittent use and individual revivification might be permissible.

OUR PETITION

SINCE our progress report last week on the 'Gas Journal' and 'Gas Service' Petition to the Chancellor, calling for the lifting of Purchase Tax and Hire Purchase Restrictions on gas-fired space heaters we have received the support of Mr. Frank Cousins and the Transport and General Workers' Union, several local authorities and a substantial number of M.P.s. Manufacturers who have signed the petition represent nearly 30,000 employees.

Personal

MR. G. W. ELLIS, District Manager and Engineer, Berkhamsted District, Watford Division, Eastern Gas Board, retired on January 31 after 43 years in the gas industry. Mr. Ellis joined the Berkhamsted Gas Company in 1914 and after a probationary period, was articled to the late Mr. C. A. W. Codgbrook, then Manager of the undertaking. In 1924, he was appointed Assistant Manager, and two years later, on the death of Mr. Codgbrook, Manager. Subsequent appointments were Secretary in 1927, Chief Engineer in 1928, Managing Director in 1931, and Vice-Chairman in 1940. Between 1928 and 1939 Mr. Ellis devoted his energies to the reconstruction of the works and distribution system. After vesting date he continued as District Engineer and Manager at Berkhamsted, as well as having responsibility for technical matters at Chesham.

MR. W. D. WILSON, Chairman and Managing Director of George Wilson Gas Meters, Ltd., was presented with a wrist watch at a luncheon in Coventry recently to mark his retirement last year as Chairman of the Coventry group of the Engineering Industries Association.

MR. J. S. EXLEY has been appointed Manager of Marketing of the conveyor and transmission belting division of BTR Industries, Ltd.

MR. JAMES E. DIXON has retired after 35 years as Manager of the Elswick Works of the Northern Gas Board (Tyneside Division). A member of the Gas Works Safety Rules Committee and Chairman of the Northern Board's Sub-Committee on Safety Precautions, Mr. Dixon was awarded the Institution of Gas Engineers' Silver Medal in 1937. MR. GEORGE W. ROBSON, Deputy Works Manager and formerly Manager of the South Shields works, succeeds Mr. Dixon. MR. W. L. MALE, formerly of the Blyth Division, has been appointed Assistant Works Manager.

MR. J. STRONG, a Director of the British Oxygen Company, has relinquished his appointment as Chairman of Quasi-Arc, Ltd., on being appointed Chief Executive Director of British Oxygen Gases, Ltd. MR. F. J. CLARK has relinquished his appointments with the British Oxygen Group of Companies.

MR. JOHN GAY, of the Chief Accountant's department at the Gas Council, gained first place in the December, 1957, final examination of the Institute of Cost and Works Accountants. He thus receives the S. Laurence Gill prize. MR. JOHN DEARDEN, a senior clerical officer in the Belfast Corporation's Gas Department, won the Donald L. Moran prize for the best paper on management (factory and distribution).

Increased Dividend

The George Cohen 600 Group, Ltd., is to pay an interim ordinary dividend of 4½% actual, less tax, on March 31, 1958, in respect of the Company's financial year ending on that date. In his Statement, issued with the annual report and accounts on August 30, 1957, the Chairman said the increase in the rate of interim dividend must not be taken as signalling an increase in the total rate of dividend for the year.

Obituary

MR. HENRY JOHN ALLEYN ALLEN, who was Works Superintendent of the Weston-super-Mare Gas Co. during 1919-1946, has died, aged 76.

MR. ARTHUR JACKSON, a Director of the Concrete Proofing Co., Ltd., has died after nearly 30 years' service with the Company.

Gastechnik Orders

Recent orders received by Robert Dempster & Sons, Ltd., Elland, for Gastechnik purifiers include a second plant for the Wales Gas Board, of 6 mill. cu.ft. per day capacity, at Aberavon, and one of 8 mill. cu.ft. per day with sulphur extraction plant, for the Southern Gas Board at Reading. Twelve of these plants have now been ordered, by four gas boards and four industrial concerns.

Diary of Forthcoming Events

February 20.—INSTITUTE OF FUEL (MERSEYSIDE SUB-SECTION): 9, The Temple, Dale Street, Liverpool: 'Heating, Ventilating, and Air Conditioning,' by C. G. Bell. 7 p.m.

February 21.—JUNIOR INSTITUTION OF ENGINEERS: Pepys House, 14, Rochester Row, London, S.W.1: Informal meeting with paper, 'Instrumentation in the Gas Industry,' by T. A. Lucas, S. Eastern Gas Board. 7 p.m.

February 21.—WALES G.C.C.: Bute Terrace, Cardiff. Meeting at 11 a.m.

February 22.—WALES AND MONMOUTHSHIRE JUNIORS (N. WALES SECTION): Colwyn Bay: Paper by Mr. J. Woodcock.

February 26.—COMBUSTION ENGINEERING ASSOCIATION (WELSH REGION): Park Hotel, Cardiff. 'Recent Advances in Space Heating,' by G. H. Buckle and 'Refractories for the Industrial Boiler and Furnace,' by N. W. Hinchcliffe. 10.0 a.m.

February 26.—INSTITUTE OF FUEL: Great George Street, S.W.1. 'Boiler Water Treatment,' by Drs. J. A. Gray, E. F. Thurston, and L. Furnival. 5.30 p.m.

February 27.—NORTH THAMES G.C.C.: Westminster City Hall, London, W.C.2.

February 27.—INSTITUTE OF FUEL (EAST MIDLAND SECTION): Gas Showrooms, Nottingham. 'Recent Developments in the Synthesis of Oil from Coal,' by Dr. C. C. Hall. 6.15 p.m.

February 27.—INSTITUTE OF FUEL (SCOTTISH SECTION): Royal College of Science and Technology, Glasgow. 'Use and Availability of Gas Coke as a Smokeless Fuel in Scotland,' by S. Smith. 7 p.m.

February 27.—INCORPORATED PLANT ENGINEERS (SHEFFIELD & DISTRICT): Grand Hotel, Sheffield. 'Atmospheric Pollution in Industry,' by W. Herring. 7.30 p.m.

February 28.—SOCIETY FOR ANALYTICAL CHEMISTRY (SCOTTISH SECTION): George Hotel, Edinburgh: Ordinary meeting including paper, on 'The Solvent Extraction of Metal Complexes,' by F. J. C. Rossotti. 7 p.m.

February 28.—INSTITUTE OF CHEMICAL ENGINEERS (GRADUATES AND STUDENTS SECTION): Caxton Hall, London, S.W.1. 'Project Cost Estimation,' by E. A. Stallworthy. 6.30 p.m.

March 4.—MIDLAND JUNIORS. 'Electrical Economy in Gasworks,' by T. Bryan.

March 4.—INCORPORATED PLANT ENGINEERS: John Adam Street, Adelphi, Strand, W.C.2. 'Plant Engineers in a Changing Britain,' by L. G. Northcroft. 7 p.m.

March 4.—INSTITUTION OF CHEMICAL ENGINEERS: The Hoare Memorial Hall, Church House, London, S.W.1. Spring Meeting, 9.30 a.m.

March 4.—SOUTH EASTERN G.C.C.: Caxton Hall, S.W.1. Committee Meeting. 11 a.m.

March 5.—INSTITUTION OF CHEMICAL ENGINEERS (GRADUATES AND STUDENTS SECTION):—Day visit to B.P. (Refineries), Kent, Ltd., at the Isle of Grain.

March 5.—JUNIOR INSTITUTION OF ENGINEERS (MIDLAND SECTION): James Watt Memorial Institute, Birmingham. Visit of the President of the Institution and Presidential Address. 7 p.m.

March 5.—INCORPORATED PLANT ENGINEERS (LEICESTER): Leicester Technical College. 'Electrostatic Filters,' by Michael Penrose, Sturtevant Engineering Co. Ltd. 7 p.m.

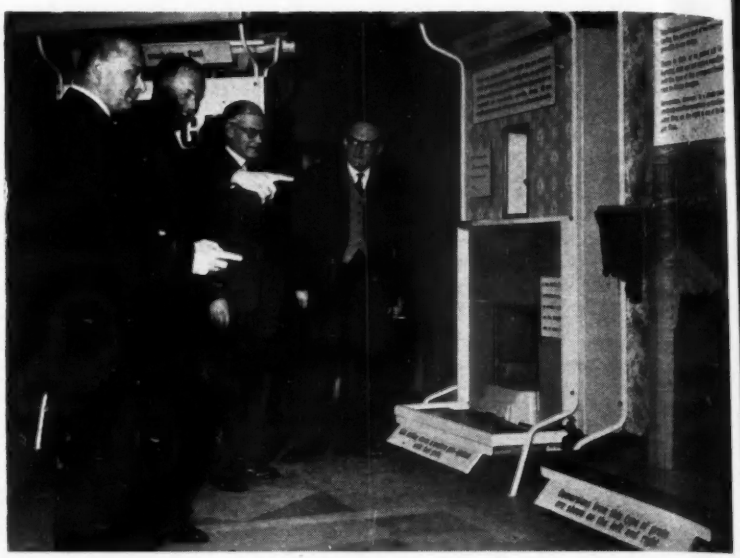
Woman Puts 466 Halfpennies in Shilling Meter

Charge of Stealing £24 Worth of Gas Dismissed

THE case against a woman charged with stealing £24 worth of gas from the Northern Gas Board by using 466 halfpennies instead of shillings in a prepayment meter was dismissed by Thornaby-on-Tees (N. Yorks) magistrates recently.

Mr. Morgan Davis, of the Board, said that there had been times when the Board had accepted odd halfpennies being used instead of shillings, but this was the worst case they had had. No one had been at the house to let a meter inspector check the readings and coins for about a year.

Mr. D. L. Bowron, defending, successfully submitted that there was no intent to defraud. When the discrepancy had been pointed out to her defendant, who had £16 a week for housekeeping, intended soon to make it good.



Seen at a clean air exhibition sponsored by the South Eastern Gas Board, held on the occasion of a meeting at Purley Council offices of the Surrey branch of the Association of Public Health Inspectors, are, left to right, Mr. R. M. Munns, Sales and Service Manager, East Surrey Division, S.E.G.B.; Mr. L. W. Pinches, Chairman, Surrey Branch, Association of Public Health Inspectors; Mr. G. H. Cockell, Hon. Secretary of the Branch; and Mr. F. S. Evans, the Board's Coke Manager.

N.G.B. BUYS MORE COKE OVEN GAS

DURING 1957, the 15 coke-oven plants of the Durham Divisional Coal Board carbonised 4.5 mill. tons of coal, an increase of 100,000 tons on 1956. More than 3 mill. tons of coke were produced, and by-products included 180,000 tons of crude tar, 36,000 tons of sulphate of ammonia, and more than 11 mill. gal. of benzole. Coke-oven gas sales to the Northern Gas Board reached a record of more than 20 mill. cu.ft.

A six-year carbonisation scheme which began in 1952 will be completed this year when a 50-battery coke-oven plant goes into operation at Murton alongside the new Hawthorn Shaft. Extensions to Monkton coke-ovens were in operation throughout 1957 and offset the closing of an older plant at New Brancepeth.

Technical Teachers

THE number of places available for students who wish to train to become technical teachers is to be increased by over 60%, and substantially higher rates of grant are to be paid to students. This follows recommendations made by a special committee set up by the Minister of Education in 1956. A new standing committee has been set up, under the Chairmanship of Dr. Willis Jackson, Director of Research and Education, Metropolitan Vickers Company, Ltd. (also Chairman of the special committee) to keep under permanent review the supply and training of teachers for establishment of further education.

GASHOLDER WILL GO BY RAIL

IMPERIAL CHEMICAL INDUSTRIES, LTD., are constructing a new gasholder at their Billingham-on-Tees works, which when completed will be moved on special rails to its selected site. The gasholder weighs more than 900 tons and will replace an existing holder which has been in use for 30 years.

Nineteen rails are being laid and when the new holder is completed it will be lifted by jacks on to trolleys and moved on to the site of the old holder.

GAS LIQUOR TRIALS ARE REVIEWED

A REVIEW by Mr. F.C. Sherriff of the extensive trials that have been carried out to determine the value of ammoniacal liquor as a fertiliser appears in the January 31 issue of the *Farmers' Weekly*. Mr. Sherriff, a one-time Assistant Editor of the 'GAS JOURNAL,' gives figures which show that in tests on kale similar yields have been obtained at a net saving per acre of £4 5s. with the use of gas liquor compared with more constitutional methods.

Concluding his article, Mr. Sherriff points out that while gas liquor is primarily a nitrogenous fertiliser it acts, at the same time, as a weed control. The farmer who uses it on his kale thus gets two jobs done for the price of one.

B.P. STRIKES OIL AGAIN IN BRITAIN

IN the course of the search for oil in Britain, B.P. Exploration has again met with success. Oil has been found at an initial test well at Langar, Nottinghamshire. Earlier this month the company struck oil at Bothansall, also in Nottinghamshire.

Further drilling will be neeeded to determine the extent of both discoveries, but first results raise hopes that they indicate new oil deposits of commercial significance. Both wells are relatively near existing B.P. oilfields.

Total output of crude oil in 1957 from B.P. oilfields in this country—Eakring and Egmanton (Nottinghamshire), Plungar (Leicestershire), and Formby (Lancashire)—was around 82,000 tons.

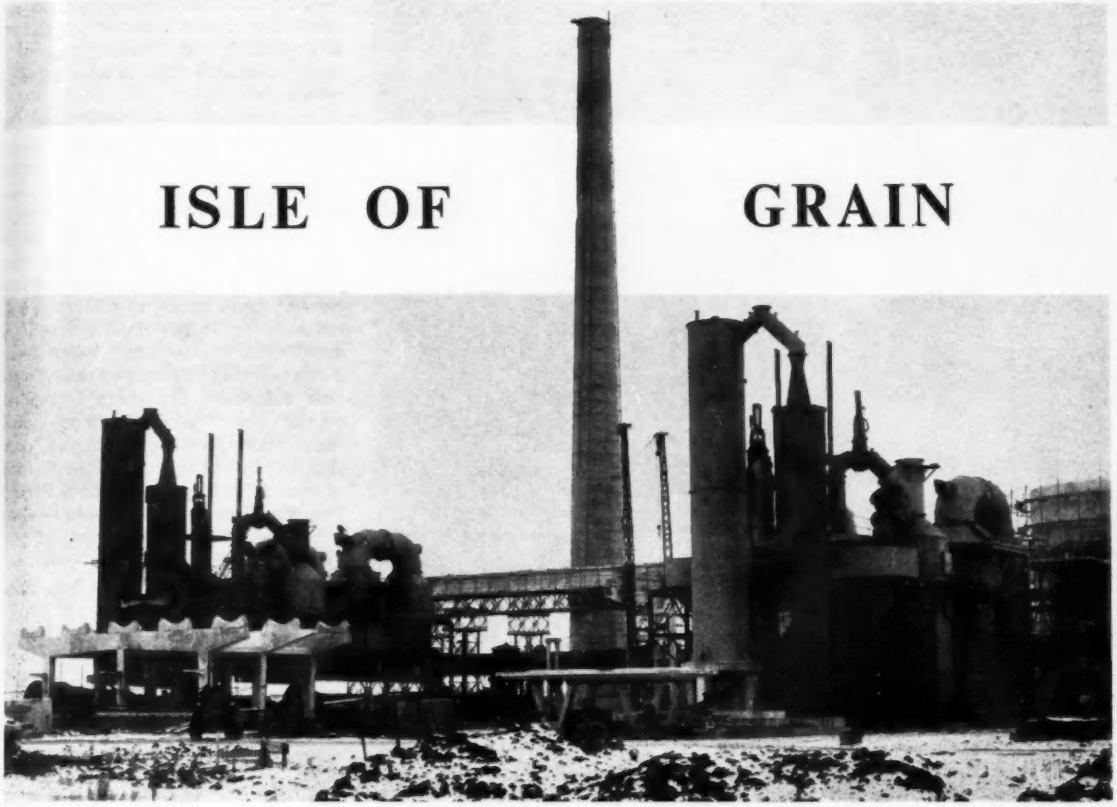
Mr. Therm's Magic

Supporting the Gas Council co-ordinated advertising campaign for water heating by gas, to appear in newspapers from March 2-29, is a colourful booklet called 'The Magic of Instant Hot Water.' Printed in six colours, this publication illustrates the ten water heating appliances featured in the advertising, and puts the case for gas succinctly and persuasively.

Long Service Awards

Four employees of the Redditch group of the West Midlands Gas Board recently received certificates and money awards for 25 years' service.

ISLE OF GRAIN



First Details and Pictures of Latest Segas Installation

THE planning of the new Isle of Grain works on a site adjacent to the Kent Oil Refinery allows for a development to a foreseen capacity of 60 mill. cu.ft. per day to be reached in three approximately equal stages. Oil gasification plant is economical in ground space requirements and the site can accommodate further substantial extensions of capacity. The gas produced at stage I will be available for marginal requirements in the Medway area, but will also be pumped into the South London grid through the new 36-in. main running along Watling Street; 20 mill. cu.ft. per day produced at this stage would be largely absorbed in the area adjoining the Thames between Gravesend and Belvedere.

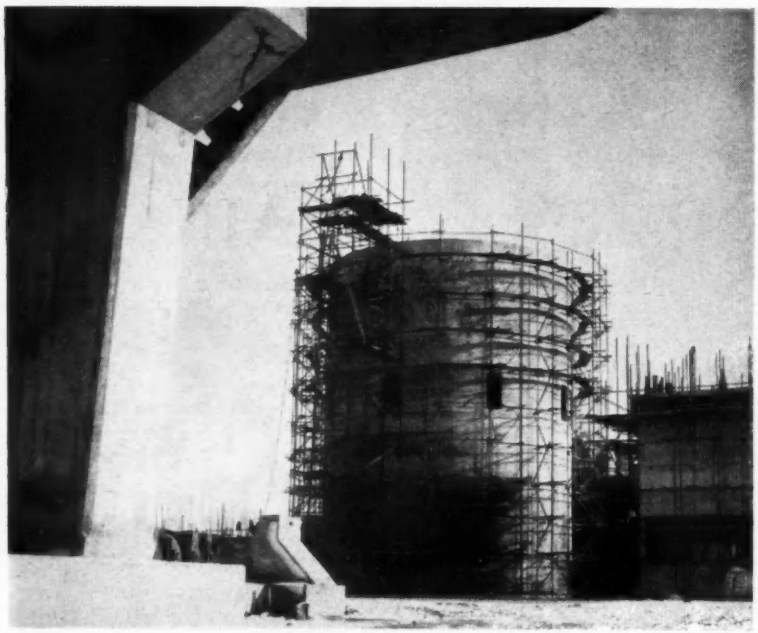
A survey of the site showed the ground to be roughly level at +7.00 ft. N.D. It contains an area of fleets or deep ditches which over the area of present development have been drained, dredged and backfilled to the general level. The road level datum of +10.00 ft. N.D. has been adopted to conform to the refinery survey and to cover H.W.O.S.T. at +9.7 ft. N.D.; the slab level for buildings and plants has been fixed at +10.5 ft. N.D. The present development at stage I covers approximately one quarter of the available site and the preparation of this area has been completed by the provision of some 64,000 cu. yd. of raise and fill.

A visitor to the Segas plant at the Isle of Grain on February 10 was Sir Harold Smith, Chairman of the Gas Council (centre). On his left is Mr. W. K. Hutchison, Chairman of the South Eastern Gas Board, and on his right, Mr. C. Stott, Deputy Chief Engineer.

Twelve boreholes have been taken out and these reveal estuarine deposits of soft clay down to 23 ft. below ground level, followed by approximately 6 ft. of gravel underlain by stiff blue clay to a substantial depth. The strata above the gravel will not take a loading of more than 0.1 ton per sq. ft., and the restricted and variable thickness of the gravel will not normally permit piling to be founded there. A pile length of 50 ft. has been adopted because the bearing capacity of the piles will depend on the cohesion of the underlying clay and to secure the necessary value a penetration of 20 ft. into this strata is required.

The Franki system of piling has been adopted to obtain an increased toe bearing value and the corrugated surface of the stem of a pile of this type will enhance the cohesion factor. The design load of these piles is 45 tons. Test loading has been carried out and a load of 140 tons gave a permanent settlement of 0.26 in. in a total settlement under load of 0.44 in.

The gas-making units will comprise four streams of Segas plant, each having a capacity of 4 mill. cu.ft. per



The pre-stressed concrete water tower will provide for storage of one day's usage of raw water and a similar quantity of treated water for boiler feed.

day, using heavy fuel oil as feedstock, rising to 5 mill. cu.ft. per day on light distillate. The three-vessel design consists of steam preheater with vaporising chamber, catalyst vessel and air preheater.

Two streams will discharge to a Lymn washer, a carbon scrubber and a detarrer. The gas from each pair of units will then be metered and discharged to a common inlet main to the relief holder. The gas stream from the relief holder will be through turbo exhausters, naphthalene washers, oxide purifiers of the tower design, and station meters, discharging to a storage holder of 2 mill. cu.ft. capacity.

The trays from the tower purifiers will be mechanically emptied by the mechanical discharging device developed by Newton Chambers & Co., Ltd. This arrangement practically eliminates manual labour on this operation and provides a substantial revivification effect on partially spent material.

The effluents from the washboxes, Lymn washers and carbon washers will be treated in circular settling ponds of special design for the removal of tar and carbon. The tar will be separated by gravity in the normal way and the carbon carried on the surface of the liquor will be skimmed off by a rotating beam and pumped away as a slurry for subsequent treatment. The settled liquor is pumped to cooling towers of the induced draught design and the cooled effluent is pumped back to the users.

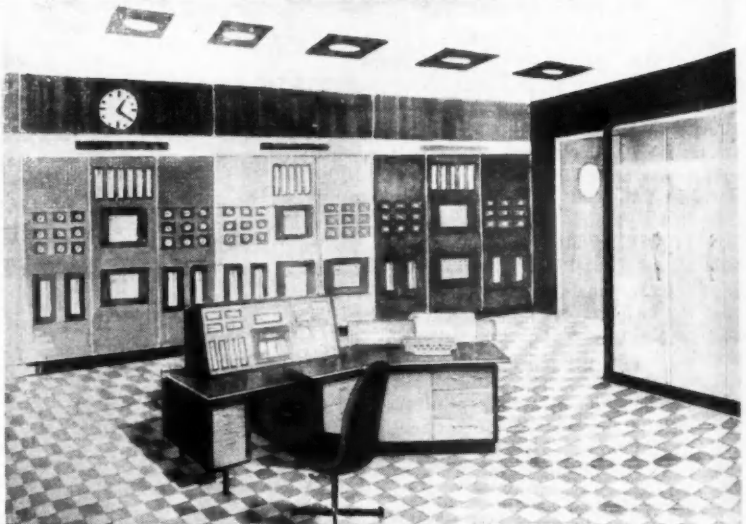
The blow gases from the Segas units, after passing through the steam preheater regenerators, will pass through a bus main to three waste heat boilers raising steam at 200 p.s.i. The waste gases discharge into a common flue leading to a chimney 220 ft. in height. The chimney shaft has been completed as a concrete shell provided with an acid resisting refractory brick lining. The design provides for an annulus to avoid overheating of the shaft.

The plant is designed for full instrumentation and automatic operation and control, thus making the minimum demands on labour requirements.

Gas will be pumped from the works at a constant rate throughout the day through some 11 miles of 30-in. steel main laid from the site to connect near Strood into the Board's 36-in. integration main. The choice of compressing machinery for this purpose is a difficult one as three, and possibly four, stages of increased output have to be covered. It has been considered, however, that the machines initially installed should provide essentially for stage I requirements, and for this purpose two compressors have been ordered, each capable of taking the stage I load against a back pressure of 8.5 p.s.i. This pressure is sufficient to deliver gas into the eastern fringe of the London area.

The compressor house has been specially designed to allow for extension. At the present stage it houses the two compressors driven by D.C. motors supplied through mercury arc rectifiers.

Two turbine driven exhausters are housed in the machinery room at this stage, and in the separate blower room are the turbine-driven blowers for the main supply of process air. This room also houses the blower for the air supply to the tower purifiers and the compressors, receivers and dryers for the supply of air for the plant instrumentation. A turbine-driven fire pump is also located here.



An impression drawing of the control room. Only three men will be required to supervise the entire production sequence. (Photo by courtesy of Elliott Brothers (London), Ltd.).

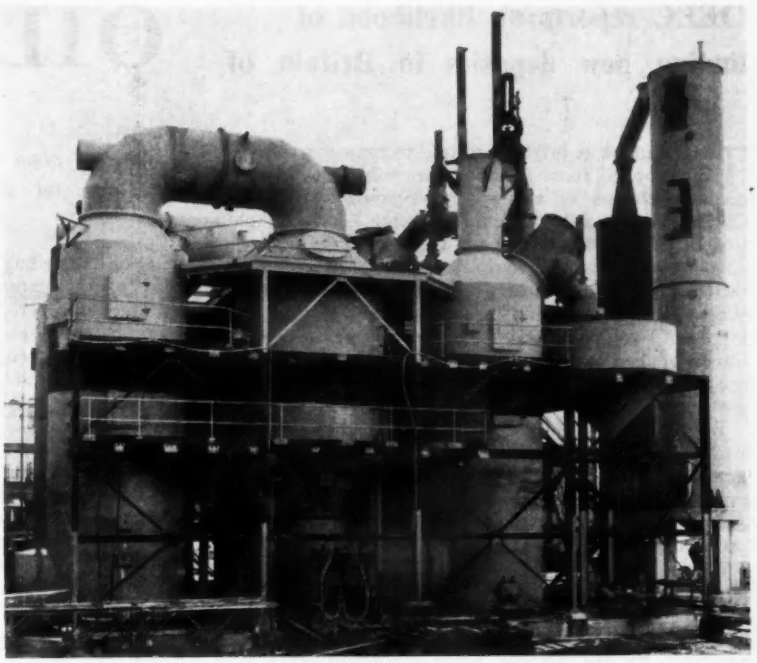
The administration block is located near the main entrance where ready access is given by a new road leading from the County Road.

The usual minor buildings have been provided for the main sub-station, switch rooms, the water softening plant and the official gas testing rooms. Other than these the plant is entirely in the open without housing of any kind.

The process steam requirements of the Segas plant are relatively high and sufficient prime movers will be turbine driven, passing out steam at 20 p.s.i. to the accumulator serving the process main. Any deficit in the overall steam requirements for power and process will be made good from the refinery steam system and the two sites are connected by a 10-in. steam main for this purpose.

Apart from these prime movers the remaining plant will be motor driven. The power will be taken from the 11-kV public supply and advantage will be taken of the two 33-kV supply lines to the refinery. This steam and power balance may be substantially modified at subsequent stages of development when sources of power internal to the works become available.

The storage of feedstock is undertaken by the refinery which will provide two 700,000-gal. storage tanks for black oil and a similar storage for light oil. Two separate 8-in. supply lines will serve the Board's site by gravity flow, the black oil line being suitably lagged and traced. Arrangements have been made with the refinery to supply wash oils of various types and to accept spent oils on their return.



This photograph shows the three units of the Segas plant. Left to right, the combined steam preheater and carburettor, the catalyst vessel, and the air preheater. Gas will then pass through the washbox and Lymn washer (extreme right).

When work first began on the site early in 1956, the deep ditches or 'fleets' covering the area had to be drained and dredged to backfill to the required level. The site is adjacent to the British Petroleum Company's Kent Oil Refinery, part of which can be seen in the background.

The refinery is equipped with a very substantial cooling water system, drawing water from the Medway. This will be extended to the Segas site by a 20-in. main. Cooling effluent, together with other effluents from the plant will be discharged to the Colemouth Creek through an effluent main laid in 24-in. concrete pipe.

The fresh water supply to the Isle of Grain peninsula is very restricted and the refinery had to augment this by sinking their own wells at Hoo and connecting them to the refinery through a 12-in. main. This supply is not potable and is for industrial use. The Board's fresh water requirements at this site are estimated at $\frac{1}{4}$ mill. gal. per day at stage I, rising to $\frac{3}{4}$ mill. gal. per day on full development. As the refinery is also carrying out an extensive development programme, the fresh water requirements on the peninsula may reach 3 mill. gal. per day. Working in collaboration with the refinery and the Medway Water Board an 18-in. supply main for fresh water is being laid from Cuxton to the refinery and as the route substantially conforms with that of the gas transmission main, gas and water mains are being laid for the major proportion of their length in a common trench under the same contract. The supply to the gasworks site will be made by a 10-in. branch taken from the 18-in. supply main.

This water will initially be a typical Kent chalk water and later might include a proportion of green sand water. The water softening plant has been based on the Permutit hydrogen ion starvation process. Water storage arrangements on site have been provided in pre-stressed concrete tanks, providing for the storage of one day's usage of raw water and a similar quantity of treated water for boiler feed.

Initially the site consisted of rough pasture and marshland with no services available. Work commenced on February 6, 1956, on the building of a causeway from the main road to provide temporary access to the site for constructional purposes. Work then proceeded on damming, draining and removal of silt from the fleets, backfilling the fleets to site level, and bringing the general fill to datum level over the area of the site required to cover the end of stage II of development.

Piling commenced on May 14, 1956, and is now complete.

D

OEEC reports on likelihood of finding new deposits in Britain of OIL and GAS

23% of the U.K. geological formation has been revealed 'favourable' for the finding of hydrocarbons

THE outlook is bright for rapid increases in supplies of oil supplied from Europe's own oilfields. This is the main conclusion of a new report prepared by the Oil Committee of the O.E.E.C. (The Search For and Exploitation of Crude Oil and Natural Gas in the O.E.E.C. Area, £3 0s. 0d.) This is a complete study of the subject and includes: A separate, large coloured geological map of Western Europe, the first of its kind, showing in detail the layout of sedimentary beds classified according to the likelihood of their containing oil; tracings showing concession areas; and a table illustrating the distribution of oil and gas horizons by geological formations.

By the end of 1956, the contribution of Europe's hydrocarbon resources (oil and gas) was still comparatively modest, some 12% of total requirements. Production of crude oil alone had risen rapidly from 3.8 mill. tons in 1950 and 7.9 mill. tons in 1954. At the present rate of progress, it should amount to 14.5 mill. tons in 1959.

Except for the greater part of the Scandinavian countries, most of the sub-soil of Europe is made up of sedimentary basins. Areas where prospects are described as favourable represent 37.6% of the total area of O.E.E.C. countries, including, for this purpose, Spain and Yugoslavia.

Since the war, vast accumulations of oil and natural gas have been discovered in Austria, France, Germany, Italy and the Netherlands; it is probable, says the report, that other large fields of this kind will be discovered in the future.

The report divides into four categories the oil prospective regions according to the possibilities of finding oil and gas: (1) Prospects definitely unfavourable; (2) prospects unfavourable or mediocre; (3) reasonably favourable prospects; and (4) favourable prospects. This last category includes 'those sedimentary troughs characterised by very thick deposits. In such cases oil and gas, at least in traces, have already been proved. All producing fields lie within such basins. This group also includes those part of basins in which definite traces of oil have not yet been found but where paleogeographical and tectonical events strongly suggest the presence of conditions similar to those existing in basins already producing. . . . One of the more surprising facts revealed by compiling the oil and gas map is that regions grouped under category 4 are widespread within the O.E.E.C. area but they have only been explored sporadically and vast tracts of land are still insufficiently known.'

In a table the report gives the United Kingdom as having 23.0% of its area in category 4, 9.0% in category 3, 37.8% in category 2, and the rest in the 'definitely unfavourable' class.

Although the following abstract from the report is of a mainly geological character, a strong outline is given of the formation areas in Great Britain; the stage of exploration reached, and the importance of the areas: —

GEOPHYSICAL INVESTIGATIONS IN THE UNITED KINGDOM

Prior to the 1914-1918 war, no serious search for oil was made in the United Kingdom. During the war, lack of indigenous oil supplies resulted in a government sponsored campaign for the search for oil between 1918 and 1922.

In the carboniferous basin of the Midlands, oil seepages had been identified many years ago in outcrops, borings and in the coalmines. Shortly after the end of the war a well was sunk at Hardstoft in Derbyshire on a small fold. Oil was found in carboniferous limestone. Up to 1954, this well produced an aggregate amount of 4,000 tons.

In 1934, after the Petroleum Act was passed, several companies started a more widespread search, principally based on geological field work, in Southern England, the Midlands, Lancashire, Yorkshire and Southern Scotland. These investigations resulted in the discovery of a few small indications of oil in the Midlands and of gas in Yorkshire and Southern Scotland.

In 1939, geophysical investigations were started in Nottinghamshire and Lincolnshire, in order to investigate concealed carboniferous rocks. This led to the discovery of commercial oil at Eakring in the millstone grit and partly in the overlying coal measures.

At the outbreak of the second world war, this sporadic prospecting was stopped and geophysical and geological activities concentrated on the carboniferous basin of the Midlands. Small anticlinal accumulations were found at Eakring, Duke's Wood, Kelham Hills and Caunton.

The Mesozoic basin of Southern England covers approximately 10,000 sq. km. This basin is a continuation of the northern part of the Parisian basin in France. The regional tectonic high where wealden and jurassic are exposed in the Boulonnais of Northern France continues under the Straits of Dover in the Wealden high of Southern England where also, at several localities, Jurassic is outcropping. The large anticline of Bray, which is a prominent tectonic feature in the northern Parisian basin, is also believed to continue under the Channel to the southern part of the Isle of Wight.

In the basin of Southern England, oil-impregnated sandstone has been found in cretaceous and jurassic. The basin has already been explored by a number of test wells. In 1955, two wells were drilled in the western part near Chaldon Herring on a surface anticline with a core of wealden, but both were dry. The deeper of the two was abandoned at 1,246 m. In the same year, a surface anticline was tested at Ashdown in Sussex by two wells. The first found some oil shows in jurassic which were tested in the second one without success. The second was abandoned in Paleozoic. Another anticline was tested 25 km. south of Ashdown and abandoned in jurassic at 720 m. Another hole was drilled in the same area near a well-known gas seepage and completed in upper jurassic as a small gas well at 360 m. Prior to 1955, a total of nine wells had been sunk without success. Results have so far, therefore, been discouraging.

Finally, we want to mention the possibility of presence of buried hills of Mesozoic and Paleozoic sediments and existence of gas and/or oil accumulations in stratigraphical traps on the flanks of such hills.

The Permian basin of North-East England covers approximately 6,000 sq. km. of the coastal area of Yorkshire. The basin forms a geosyncline with permian limestone exposed at the western edge. Triassic and jurassic outcrop further to the east. In the south, upper cretaceous chalk overlaps the jurassic sediment.

The permian is developed in its upper part as anhydrite and dolomotic limestone, whereas its middle part consists of anhydrite and its lower part of dolomitic limestone.

Based on geological evidence, a well was drilled at Eksdale where, in a salt-bearing sequence of limestone of upper permian, gas was discovered in 1939, at 1,295 and 1,460 m. The search for gas in the North-East England basin is still

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being continued. In 1955, core drilling was being done some 30 km. south of Eksdale in order to investigate structural conditions.

The carboniferous basin in the south of Scotland is another small basin, covering approximately 4,500 sq. km. In the area surrounding the Firth of Forth, carboniferous limestone of the lower part of the formation is exposed and some oil and gas indications have been observed in outcrops and borings.

A substantial amount of gas with some oil was discovered at shallow depth (470-640 m.) in 1937 at Cousland (Midlothian) in the above-mentioned limestone. Other wells have also been drilled in recent years, but so far without success.

The sediments of the carboniferous basin of Lancashire (about 5,700 sq. km.) are exposed around the Liverpool Bay. Coal measures of the upper carboniferous are outcropping and Keuper marl with sandstone and Bunter sandstone are exposed near the coast. Strong oil seepages occur at Peal, near Formby, near which a well was drilled which found some oil from 28 to 38 m. in Lower Keuper sandstone. In 1953, a core drilling campaign was initiated near Formby but no encouraging results have yet been obtained. Test wells at Leeswood (1,093 m.) and Croxteth were unsuccessful. The basin is believed to extend under the Liverpool Bay.

The carboniferous basin of the Midlands is the largest (16,000 sq. km.) of the United Kingdom and has so far attracted most of the oil prospectors' attention. It is the seat of the Eakring oilfield, the first and largest field yet discovered in the United Kingdom.

The upper carboniferous consists of coal measures overlying millstone grit which lies above limestone and calcareous sandstone of the lower carboniferous. The coal measures are composed of shale, sandstone and layers of coal, the underlying millstone grit consists of coarse sandstone and, in places, conglomeratic and marine shales. There seems to be little doubt that the commercial oil production from sands in the coal measures has migrated from the millstone grit with its marine source rocks.

The coal measures have been folded and faulted by the Armorican folding phase. Most of the accumulations of oil are due to trapping against faults but a few are connected with folds. In recent years, in addition to the fields at Eakring, Duke's Wood, Kelham Hills, and Caunton (discovered during the period 1939-1944), a new field of medium size has been found at Plungar, and another in 1955 at Egmonton. Both these discoveries were defined by reflection and refraction seismic surveys. The latter field now seems to be producing substantial quantities of oil.

The Paleozoic basin of the Southern Midlands covers approximately 12,000 sq. km. It lies north of the Mesozoic basin of Southern England. Some gas shows have been encountered in the area in boreholes.

Upper jurassic oolites (a kind of limestone) are exposed in the north part of the basin. Further to the south, these sediments are overlapped by lower and upper greensands, which, still further to the south, merge into upper cretaceous chalk series.

Occasional shows of gas have been found in boreholes. As far as is known, some years ago, only one well has been sunk to a depth of 815 m. for exploration purposes. In 1955, a well was sunk in Berkshire in the upper jurassic oolites but was abandoned at 950 m. in Devonian. There seems little doubt that this basin has, as yet, been little explored.

The total area of the basins listed in a table of the report is approximately 54,000 sq. km. spread over six basins including three of 10,000, 12,000 and 16,000 sq. km. respectively. It may safely be concluded that the oil possibilities in the basins of the United Kingdom have not yet been sufficiently explored. Taking into account the presence of mother-rocks, the oil accumulations in the upper Paleozoic as well as the considerable size of the basins, further prospecting for oil and gas seems fully warranted.

GAS IN FRANCE

REPORT SHOWS SALES INCREASED BY 10%

THE December issue of *Journal des Usines à Gaz* contains a summary of the report of Gaz de France for the year 1956. Because of the growing diversity of calorific values of gas distributed, sales are henceforth to be reported in thermies (1 thermie = 0.04 therms, approximately). In the course of 1956 sales amounted to 13,600 mill. thermies, corresponding to 3,400 mill. cu.m. reduced to 4,200 kcal (120,000 mill. cu.ft. at 440 B.Th.U.), an increase of 10% over 1955. Two-thirds of the demand was met by installations of Gaz de France, the remainder by purchases of natural gas, gas from the coke ovens of the mining and steel-making industries, and oil refineries. By comparison with 1955 the production of the gas industry itself noticeably advanced, necessitating a noticeable increase in the quantities of coal and petroleum products treated. But the demand could only have been met by a particularly large increase in purchased gas which increased by nearly 30%.

Coke available for sale by Gaz de France increased to 2,530,000 tonnes compared with 2,200,000 tonnes in 1955. Total sales reached 2,561,000 tonnes. A particular effort was made to develop sales of creosote for export. Internal markets were influenced unfavourably by imports of pitch, notably from Eastern Europe. Agreements have been signed with tar distillers in the Paris region with a view to a development of the market for road covering in that region.

Prices of coal and petroleum products went up while the price realised for gas went slightly down, but with an increase of the price of coke the net result on balance of working was very small. The number of domestic consumers increased by 100,000 in 1956, against 84,000 in 1955 and 55,000 in 1954. The number of domestic consumers, situated in zones covered by complete agreement with regard to sales covering all trades interested in the sale of gas appliances, increased from 79% in December, 1955 to 83% in December, 1956. Taking into account several partial agreements, notably with installers of apparatus, the percentage reached 90% at the end of 1956.

Extensions of storage capacity and transmission lines at high, medium and low pressure are reported. Thirty-three gasworks were shut down in 1956; 16 of these were replaced by air/propane plants, one by an installation reforming refinery gases, ten by grid schemes and six were abandoned altogether. The number of works shut down since nationalisation has risen to 225.

Peak loads in the Paris region are now met to an effective extent by the underground storage at Beynes. Ten wells have been sunk to a depth of 450 m. A compression and purification station has been equipped and a steel main laid between Beynes and Viroflay where distribution, regulation and conditioning plant is installed. By the end of the year 4 mill. m^3 of coke oven gas was stored underground. Tests have been satisfactory and have supplied the data for the formulation of the programme to equip the reservoir for a total capacity estimated at 300 mill. cu.m. (say, 10,500 mill. cu.ft.). The progressive development of this work should lead, in the course of the winter 1959/60, to a possible annual withdrawal of 150 mill. m^3 (say, 5,000 mill. cu.ft.) with a daily availability of 2½ mill. m^3 (say, 88 mill. cu.ft.) of peak load gas. The exploration of other possible underground reservoirs continues. Reference is made also to progress in other techniques in production, distribution and utilisation, and security. Advance in productivity is indicated by reduction in effective personnel to 31,981 from 32,143 in the previous year. Gaz de France has begun the construction at Versailles of a new group of schools with internal places for 120 students.

The Editor of *Journal* asks the rhetorical question, 'What will be the results for 1957?' Sales will show a notable advance, but certainly less spectacular, 1957 not having suffered the extreme cold of the early months of 1956. September statistics showed an increase for the period April-September of nearly 4% over the similar period of 1956, but it is not impossible that the results of November-December will not reach this figure.

From a paper to the Manchester and District Junior Association of Gas Engineers, December 12, 1957.

Some Difficulties Experienced with the Condensers on an I.V.C. Plant

By O. H. BARNES,

STUDENT APPRENTICE, WEST LANCASHIRE GROUP,
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THE purpose of this paper is to present a short history of the condensers on the I.V.C. plant on the Lostock Hall works of the North Western Gas Board. It provides no new information about condensers; but is simply an account of the difficulties experienced in the operation of a unit which in practice failed to meet its specified duty requirements.

The I.V.C. plant is designed to produce 4.2 mill. cu.ft. of gas per day at a c.v. of 520 B.Th.U. per cu.ft., which is suitably diluted with C.V.R. gas and water gas to produce gas at the inlet of the holder with a c.v. of 450 B.Th.U. per cu.ft.

The retort house consists of two benches of four beds, each bed containing five chambers. Each chamber carbonises about 4 tons of coal a day. The gas rises in the gas offtakes which are of the swan-neck design, and is collected in a common main. Each gas offtake has its own individual liquor spray. The common main which extends for the length of each bench has two rising mains, each fitted with two liquor sprays which terminate in the overhead foul gas main. Gas from the bottom offtakes is collected in a common main which acts as a tar main and a riser from this main conveys the gas to the top collecting main over adjustable weir plates, thus maintaining the seal, into a pipe and thence to the decanting tank. A Bryan Donkin gas governor and by-pass, supplied with suitable liquor sprays to prevent blockages, is fitted to the end of each foul main. The coal gas streams are then joined together and led in one stream from the governors to the ancillary plant. The first unit of the ancillary plant is the condensers and these are situated adjacent to the retort house. The gas stream passes from the condensers to the exhausters and thence to the remaining ancillary plant.

In the early planning stages the North Western Gas Board invited tenders for condenser plant to suit the following specifications.

Condenser Plant

The condenser plant was to be of vertical M.S. tubed design, capable of dealing with 180,000 cu.ft. of gas per hour entering at a temperature of 175°F. and cooling it to an outlet temperature of 60°F. The unit was to be in two sections, which would enable one unit to be retubed and the other to take the overload using an increased amount of cooling water while this work was carried out. A figure of 100°F. was the required outlet temperature of the one unit when taking the overload and using increased quantities of water. The maximum back pressure was to be 2 in. W.G. The condensers were to have open top water chambers to enable the water tubes to be brushed and cleaned with the condensers still in operation. The outlet water temperature was to be restricted to 120°F. to prevent possible corrosion of the M.S. tubes which had occurred at some undertakings using temperatures in excess of 120°F. Information on the type and amount of water available was given and the requirements for the condenser were to be stated, giving the amounts of town water and recirculated water needed for various inlet gas temperatures. Certain structural specifications were to be adhered to; these included the demand that water connections were to be in C.I. pipe and the steel body outside plates and the bottom plates were to be of $\frac{3}{4}$ in. minimum thickness. Division plates forming passes were to be at least $\frac{1}{2}$ in. thick and the tubes at least $\frac{1}{8}$ in. thick. Included in the specification was the clause that defects in the condenser causing failure to meet specified duty would be remedied free of charge for one year.

The condenser unit finally installed comprised two condensers, the first with an area of 4,690 sq. ft. and the second with an area of 4,700 sq. ft. This gave a total water cooled surface area of 9,390 sq. ft. The water requirements were 11 gal. of fresh water (town water) and 71 gal. of recirculated water for each 1,000 cu.ft. of gas per hour, *i.e.*, a total maximum demand of 82 gal. per 1,000 cu.ft. of gas per hour. The first gas taker had two water and two gas passes, the second unit had four passes in both the water and the gas sections. Each condenser had a 30 in. deep seal pot connected to the condenser by a 3 in. run off main. The town water was supplied through a 3 in. main feeding directly through a bent pipe in to the top water chambers. The town water inlet was on the last two passes of the second gas taker and on the last pass of the first gas taker. The town water was used on the last two passes of the second gas taker to bring about the necessary cooling down of the gas to 60°F., because the gas outlet temperature cannot approach nearer than 5° to the inlet water temperature. The temperature of the recirculated water would have been too high for it to be used as the final cooling agent.

Recirculated water inlets are provided in the last and second passes on the second gas taker and on the second pass of the first gas taker. The amount of recirculated water passing into the unit was to be controlled by an Arca regulating valve operated by water pressure variations which were transmitted by a thermo relay situated in the outlet main from the condenser unit. The amount of water passing would thus be varied to keep the outlet gas temperature constant. The condensate from the seal pots was run through 3 in. mains into a separating tank situated above ground level and the condensers themselves were mounted on mass concrete foundations 5 ft. 8 in. above ground level. Under normal conditions the condensers were to be run in series, the water out of the second gas taker being led straight through into the first gas taker by a connecting main. The amount of water flowing through the system was measured by a graduated V notch situated in an overflow box at the water outlet of the first gas taker. Adequate temperature instrumentation was supplied by four mercury-in-steel capillary thermometers, which were to measure the temperature of the gas inlet, gas outlet, the water inlet and the water outlet. A U type water gauge was supplied to measure the differential pressure across the condenser unit and a recording instrument to record both the outlet gas temperature and inlet water temperature on the same chart.

Bureau and Silver

All the tubes were M.S. electric resistance welded, 22 ft. $1\frac{1}{2}$ in. long and 10 gauge thick (0.128 in). Each tube was swelled $\frac{1}{16}$ in. in diameter for 3 ft. at one end only. All the tubes had square ends which were annealed before expanding into the tube plates. Facilities were provided for flushing the condensers by connecting a supply of liquor to the 3 in. flushing manifold. This manifold fed into 1 in. branches leading to the top of the gas chambers in the condenser. On the first gas taker there were two flushing pipes and on the second gas taker three. The liquor was sprayed from these pipes on to liquor spray plates which were $\frac{1}{4}$ in. plates, drilled with holes $\frac{1}{4}$ in. larger in diameter than the tubes and which were fastened in the top of the gas passes about 4 in. below the top tube plate. Steaming points were also provided on the opposite side to the flushing points. On the first gas taker,

there was one at the bottom of and one half way up each gas pass and on the second gas taker, one in each half of the bottom section of the gas chamber and one half way up each of the gas passes. In the gas section of the first gas taker there were two vent plugs, situated on the side of the condenser nearest to the platform and on the second condenser there were three similar vents, the third being in the centre of the top gas section. On both condensers there were two manholes in the gas section, situated at the bottom and two manholes in the bottom water chamber. This water chamber was fitted with two draining pipes fitted with suitable valves.

The hot return water flowed by gravity from the condensers to the cooling towers where it flowed down over boards against a forced draught which was maintained by large propellers driven by electric motors at the top of the tower. With towers of this type it is possible to approach to within 4°F. of the wet bulb temperature of the air: This is normally about 55°F., although it may reach 62°F. in summer. The water fell into a sump where it was picked up again by the water circulating pumps. A branch was taken off from the condensers so that hot water could be pumped by the boiler feed tank pumps to the boiler feed water tank. There is an air vessel in the branch pipe feeding these pumps to eliminate air from the system. The cooling towers were built up in three sections in the middle section of which there was a ball valve connected into the town water make-up line leading to the condensers. This ball valve was fitted with a by-pass. The position of the ball valve regulated the amount of make-up water which was fed into the system through the town water inlets on the condenser so that the level of water in the sump determined the amount of town water make-up required. This fresh water make-up is required to satisfy boiler feed requirements and to make up losses on the rack coolers on the effluent plant and evaporation losses on the cooling towers themselves.

Gas Makes Low

The I.V.C. plant started gas-making on November 22, 1956. The gas makes were low and the condenser appeared to be working satisfactorily. The contractors' plant operators were having difficulties with the producers which were fusing up rapidly due to the use of a low-grade coke. Since this prevented the temperatures in the settings being raised sufficiently for the carbonising cycle to be reduced to 12 hours, the gas makes were low for some time. As the gas makes increased the outlet gas temperature of the condensers began to rise well above 60°F. During the early stages of the plant operating it was noticed that the condenser water circulating pumps were not delivering the required amount of water, but because of other more pressing demands on the plant, the cause was not investigated. When, however, the outlet condenser temperature began to rise, it was thought to be due to the pumps not delivering the required amount of water. The actual capacity of the pumps was, therefore, determined by a series of tests on the cooling towers sump. The results of some of the tests were as follows:

Using *one* pump		
Loss in B. and D	10,343 gal. per hour	
Gain in A.	10,103 gal. per hour	
Boiler feed and evaporation loss	240 gal. per hour	
Using *both* pumps		
Loss in B. and D.	13,470 gal. per hour	13,780 gal. per hour
Gain in A.	12,100 gal. per hour	12,140 gal. per hour
Boiler feed and evaporation loss	1,370 gal. per hour	1,640 gal. per hour

The designed duty of both the condenser water circulating pumps is 260 gal. per minute against a 50 ft. head, and both the effluent plant water circulating pumps are rated at 292 gal. per minute against an 80 ft. head. These tests showed that the pumps were working well below designed capacity, and it was arranged with the manufacturers to carry out joint tests with the board's representative on both the effluent plant and the condenser circulation pumping systems.

Meanwhile a connection had been made between the outlet of the effluent plant pumps and the outlet of the condenser pumps. Although it was now possible to supply more than the required amount of water to the condensers for the first time, flooding occurred over the top of the second gas taker. To prevent this the water flow had to be reduced. A consultant from the condenser manufacturers, who had been called in, considered the area of the water section of the second pass of the second gas taker to be too small to deal successfully with the amount of water required. A cover was, therefore, designed and fitted to the second gas taker. From calculations on the water level in the vent pipes fitted, the required increase in depth of the top water chamber to give a sufficient head of water could be found. But the outlet temperature continued to rise, there was trouble with naphthalene, and there were difficulties in working of the static washer due to inadequate gas cooling by the condensers. Further tests on the cooling tower sump showed that one condenser pump was delivering 10,317 and 10,030 gal. per hour, and that the effluent plant pump delivered 14,294 and 13,990 gal. per hour.

Increased Head

The cover of $\frac{3}{16}$ in. stiffened plate made to the finally approved design, was fitted on the second gas taker. The water inlet on the cover consisted of a 6 in. bore tube welded on to the cover with a flange joint 6 in. above the cover. On to this flange the tundish was attached. A water meter was connected into the town water line at the top of the condenser and the ball valve in the cooling tower sump was bypassed and the float removed. It was now possible to force the water under pump pressure through the water section of the second gas taker using either both the condenser pumps or one of the effluent plant pumps. The increased head against which the condenser pumps now had to work would possibly further reduce the amount of water delivered by the one condenser pump. The water flow was increased in an attempt to lower the outlet gas temperature, but a further difficulty arose. The water passed through the first gas taker without any flooding, but when it reached the overflow box beyond the V notch there was a tendency for the water to back up and flood over the top of the box. The V notch was, therefore, removed in an attempt to eliminate any restriction, but was replaced as there was no improvement. The water flow had to be reduced to prevent any more flooding. The cause of the flooding was thought to be due to the loss of effective head of water back to the cooling tower. This reduction of head was due to the entrainment of air in the water. The effective head of water to the towers is 5 ft., and the size of the return pipe would be large enough to deal with the amount of water passing, under normal circumstances.

Series of Tests

A joint test was carried out by the condenser manufacturers and the North Western Gas Board. The required amount of water as given in the manufacturers' tender was available and the inlet gas temperature was below the specification figure of 175°F. The total water flow was obtained by means of the graduated V notch and the town water make-up supply was metered. A series of tests was carried out and the results are shown in Table I. All thermometers were checked and adjusted when necessary.

From the results a heat balance was worked out:—

Average town water = 2,200 gal. per hour at average inlet temp. 50°F.
Average total water flow = 15,000 gal. per hour.
Therefore, average recirculated water = 12,800 gal. per hour at average inlet temperature 58°F.
Average water outlet temperature = 101°F.
Average gas flow = 150,000 cu.ft. per hour.
Average inlet gas temperature = 173°F.
Average outlet gas temperature = 81°F.
Mean inlet water temperature = 57°F.
Outlet water temperature = 101°F.

Temperature rise 44°F.

Heat removed by water = 150,000 × 44 B.Th.U. per hour.
Gas flow = 150,000 cu.ft. per hour.

Therefore the heat content of the gas = 44 B.Th.U. per cu.ft.

For a balance the difference in heat content of gas at 173°F. at 81°F. should also equal 44 B.Th.U. per cu.ft.

Assuming inlet temperature to be saturated the heat content

Test No.	Town water flow gal.	Town water inlet °F	Recirc. water inlet °F	Gas inlet °F	Gas outlet °F	Water outlet °F	Total water flow gal.	Gas outlet 1st condenser	Gas flow 1,000 ft. per hour
1	2,340	51	57	171	81	100	14,500 —15,000	140	151
2	2,740	50	57	172	79	100	15,000	142	152
3	2,230	50	58	172	80	100	15,000	144	152
4	2,000	49	58	173	82	102	15,000	146	152
5	2,000	49	59	174	85	104	15,000	147	155
6	2,000	49.5	60	174	77	100	15,000	144	140

Differential pressure across condensers during test = 0.70 in. W.G.

TABLE I.

of the gas was determined by the graphs of Bureau and Silver for the heat content of gas at various temperatures.

Bureau's graph

Heat content at 173°F. = 42.6 B.Th.U. per cu.ft.
Heat content at 81°F. = 2.3 B.Th.U. per cu.ft.

Therefore heat content of the gas = 40.3 B.Th.U. per cu.ft.

Silver's graph

Heat content at 173°F. = 44.3 B.Th.U. per cu.ft.
Heat content at 81°F. = 2.9 B.Th.U. per cu.ft.

Therefore the heat content = 41.4 B.Th.U. per cu.ft.

Average heat content = 40.8 B.Th.U. per cu.ft.

There would appear to be an error of 8% in the heat content of the gas.

There was some controversy over the resulting heat balance, although from the outlet temperature obtained during the test on only 85% full gas load, it was obvious that the condenser was not fulfilling its required duty capacity. The high temperature at the outlet of the first condenser showed that this unit could not be satisfactorily used by itself if the other condenser was out of action for retubing etc. Assuming the inlet temperature to be reading low, then from the heat content removed by the water, the inlet temperature can be calculated from Silver's graph of heat content.

Heat content at 81°F. = 2.9 + 44 = 46.9 B.Th.U.

Therefore the inlet temperature = 175°F.

This temperature is the maximum inlet temperature as specified in the tenders.

A similar cover to that on the second gas taker was provided for the first gas taker. The 6 in. water main from the outlet of the second gas taker to the inlet of the first condenser had six right angle bends in it and there was also a tee-piece connected to the hot return pipe. In order to reduce the resistance of this connection and so reduce the pressure head on the pumps, it was decided to put a straight through connection between the two condensers.

Thermometer Reading Wrongly

At a subsequent visit the condenser manufacturers' representatives made certain observations for themselves. The inlet thermometer was found to be reading wrongly, which gave sufficient cause for not proceeding with any tests. An investigation of the first gas taker's second pass found that the water in this section was passing up half of the tubes in the wrong direction and at temperature in excess of 120°F. The cause of this thermocirculation was thought to be the low velocity of the water through the pass, and arrangements were made to install additional water passes in this condenser. By increasing the water passes to six, the contractors expected to reduce the outlet temperature to between 110° and 120°F. and by using increased water up to 120 gal. per 1,000 cu.ft. of gas, hoped to achieve a temperature of about 92°F., these figures being relevant to an inlet temperature of 175°F. Prior to the modification to six water passes, the contractors proposed fitting the cover on the first gas taker to calculate the required increases in the top water chambers. It was finally decided to delay the fitting of the cover until after modification to six water passes.

The failure of the pumps to supply their specified amount of water gave some concern and arrangements were made for tests to be carried out under the supervision of a representative of the manufacturer. In order to measure the pump delivery, the V notch and the change in levels of the cooling tower sumps were both used and compared. The V notch gave a slightly smaller water volume than that found from the tower sump levels.

Final Finishing Overlooked

For a designed duty of 260 gal. per minute, the readings were 175 and 183 gal. per minute respectively under a 51 ft. head. Later, the pumps were stripped and the impellers examined. These were found to be thicker than designed and the final finishing had apparently been overlooked. The impellers were too thick at the blade tips and too wide at the sides; these faults were corrected by filing the impellers to the correct shape and the pumps were reassembled. A further test on the delivery of the pumps was carried out and gave a figure of 174 gal. per min. under a head of 55.3 ft. The performance curve showed that delivery was at a maximum when at the designed duty of 50 ft. head but tailed away rapidly with increased head of water. It was evident, therefore, that the condenser pumps were delivering as much water as could be reasonably expected under the conditions of increased head. Since the reason for the failure of water supply was the increased head of water, the fault lay not in the pumps and water supply but in the design of the supply to the condenser itself.

To reduce this head, it was decided to couple up the recirculated water supply to the 6 in. main on the condenser and to cut out the present 4 in. connection and the controller valve. A temporary supply to keep the condenser in service was fitted into the tundish pipe welded on to the cover providing the normal town water supply of make up water by extending the pipe using a T-piece on to which the supply was connected. The condenser was thus still in operation when the new 6 in. pipe for inlet recirculated water was installed.

The work of modification of the water passes in the first taker entailed the condenser being out of operation for nearly a day, so arrangements were made to reduce the makes considerably. The carbonising cycle was increased to 18 hours, and on the actual day chambers due for discharge were left standing. The modification of the top water chamber was to fit two new ½ in. dividing plates to split the top chamber into four divisions. The bottom water chamber required dividing plates fitting to divide the chamber into three sections. The position of one plate was such that two of the tube plate supports had to be removed to a new position. The plates for the bottom water chamber had to be inserted through the two manholes provided in this section. On completion of the modification, the cover was fitted on the first gas taker. This was of similar design to the one previously installed and had similar jointing strips. The water inlet on the cover

was through a 6 in. bore pipe, and the town water inlet was suitably raised to feed into this pipe by use of the special flanged pipe off the second gas taker's town water inlet.

The condenser unit was put back into operation and the makes brought back to normal. The modification might have reduced the tendency for thermocirculation to occur, but the performance did not improve sufficiently to reach the figures quoted by the contractor. The recirculated water had been used from the start on all the passes of the second gas taker in an attempt to reduce the temperature by using the increased amount of water via the water section of the last two passes. Previously the water velocity in the passes of the first gas taker had been 0.19 ft. per second and 0.15 ft. per second through the first and second water passes respectively on 15,000 gal. per hour. The modification increased these velocities to 0.515 ft. per second, 0.605 ft. per second, 0.605 ft. per second; and 0.492 ft. per second, 0.492 ft. per second, and 0.415 ft. per second, reading through the water passes in direction of water flow. After the first condenser had been converted to six water passes, the unit still failed to perform its required specification duty. It became obvious that the condenser unit would require extending if the I.V.C. plant was to be able to work at full capacity. The first proposal was to utilise the mains from the serpentine condensers at the Leyland and Chorley undertakings, which had closed down. The scheme was to use these mains to construct an atmospheric condenser, of four racks each of eight layers of 12 in. mains, fitted with suitable bends. A common 24 in. main would form the inlet, and there would be a similar 24 in. main forming the outlet at the bottom of the racks. The total length of pipe would be about 1,232 ft., giving an air cooling surface area of about 3,980 sq. ft. Calculations, however, showed that this design would be too small for the duty required, and other suggestions were sought. The scheme which has been finally adopted makes use of a second-hand water cooled condenser, obtained from an undertaking which has closed down. The water cooled surface area is about 6,000 sq. ft. This condenser is to be placed in series in front of the existing unit in the gas stream, and the water connections from the existing plant will be arranged so as to give either series or parallel connections of the water flow, the normal working being series at counterflow to the gas stream. The condenser to be installed, according to available information, has four water passes and possibly four gas passes. The concrete mass foundation block has already been built and the gas valves required have arrived on the site. The condenser contractors have agreed to overhaul the condenser before it is installed and have now agreed to erect it on the site. The work is expected to be completed and the condenser in operation by the end of December, 1957. The condensate removal presents no problem, a main being run from the seal pot to the existing primary separating tank, which is built of C.I. sections above ground level.

A number of points are raised in the paper which might indicate the causes of some of the difficulties encountered when the condenser plant was put to work.

Never Reached

The first unsatisfactory point would appear to be the quoting of an inlet gas temperature of 175°F. This figure has never been reached in practice, and the temperature has been continually 3°F. or so higher. It is possible that the gas could be made completely saturated by the introduction of more liquor sprays in the retort house. This would not materially alter the total heat content, but only transform sensible heat into latent heat at a lower temperature. In spite of the difference of opinion over the tests carried out on the condenser, it has been found in practice that the surface area of the condenser is not large enough for the load put on to it. Taking the quoted requirements as specified, an area for a suitable condenser has been calculated as being 8,630 sq. ft. A gas velocity of 5 ft. per second has been chosen as a suitable starting point, thus the surface area calculated is not relative to the actual design of plant installed. The area required as calculated by Bureau's method is 8,900 sq. ft., and this is lower than the actual figure used in the condenser installed, which has 9,400 sq. ft. of water cooled surface area. This calculated required area could conceivably be much higher because the evaluation of a condenser tested by Silver, using Bureau's method, gave a required area of 7,240 sq. ft., whereas 10,130 sq. ft. was necessary to do the duty. A 20% increase due to the introduction of the fouling factor is to allow for the high heat transfer coefficients obtained by Bureau.

Silver's method, which is likewise open to much constructive criticism, gives a figure of 12,800 sq. ft. This figure for the required area would appear to indicate that the cooling surface of the condenser unit now in operation was short of some 3,000 sq. ft. The water requirements as calculated in the above methods are lower than the figure actually employed, and this should improve the deficiency in area, though in practice this has not been found to be the case, since the outlet temperature was still too high. The average gas velocity through the condenser, based on volume at S.T.P. over cross sectional area of pan is 8.5 ft. per second. At higher velocities, the overall heat transfer coefficients increase and this should thus call for a reduced area, but in practice the condenser has failed to work at its specified duty requirements. The water velocity through the water section of the second pass in the four pass condenser at the flow of 15,000 gal. per hour was 0.27 ft. per second, which is above the critical velocity. This prevented thermoturbulence which could persist at velocities 2½ times the critical velocity. Normal water velocities in modern vertical condensers of between 0.1-0.3 ft. per second are rather close to the critical velocity so that flow may tend to become thermoturbulent. This required flow of 0.27 ft. per second needs a pressure head of four feet of water to cause it to flow through the remainder of the condenser (noted from observations of vent pipe dips). This would appear to indicate a small water pass area, since normally a head of 12 in. to 18 in. of water would be considered sufficient to ensure the correct flow of the water through a condenser. The figure seems high when compared to the original water velocities of 0.19 ft. per second and 0.15 ft. per second in the first gas taker, which were low enough to cause thermocirculation. The modification increased the water velocities in the first gas taker and so approached the desired aim of having higher water velocities in the hot gas passes to overcome the high water film resistances found in this part of the condenser.

The design of a condenser involves the balancing of gas velocity, water velocity and aspect ratio (*i.e.*, ratio of length to area of passes) bearing in mind the pressure losses involved. In practice it has been proved that the condenser installed has failed to fulfill its specified duty requirements, even when only on 85% full load.

DISCUSSION

Mr. J. K. Lord, President, thanked Mr. Barnes for his paper. Regarding the possibility of using atmospheric condensers which the author had turned down, Mr. Lord asked if the author had considered using this purely as an atmospheric condenser or an evaporation condenser—that is, with water trickling outside the surface and using the cooling effect of evaporation to give greater cooling.

Mr. Barnes replied that it was decided that perhaps it would be better to utilise the existing mains at Leyland and Chorley but after calculations it was found that the surface area available would be too small. Mr. Lord asked the author if he considered the surface area was sufficient, and the author replied that he did not think so.

Mr. C. R. Hollingshead asked what apparatus had been used to obtain the wet and dry bulb temperatures, and what temperature the author considered could be reached on the condensing system before shutting down the carbonising plant. Mr. Barnes replied that the wet and dry bulb temperatures were put in the paper merely for completion. They were not actually used in the various negotiations between the condenser firm and the Board to any reasonable advantage. He believed they were used merely as an argument. Wet and dry bulb temperatures were only obtained in rough method. It was realised that to get a true wet and dry bulb temperature it would require quite expensive apparatus. The only way it could be carried out was to take a plug out of the side of the condensing unit in the top of the gas pass and insert a thermocouple of suitable material. Mr. Barnes said he did not know what the outlet temperature on the condensing unit ran out to, but from trouble experienced on the static washer

with naphthalene, he would say it could continue much longer with temperatures above 90° in certain circumstances.

Mr. L. Brook said he was puzzled by the fact that the Arca flow valve was on the recirculated water, although maybe this was answered in the paper. It seemed quite possible that by taking hot water from the boilers there would still be make-up water required. He said he thought the Arca valve would have been better on the make up water inlet, and asked what was the basis for it being put there in the first place. Mr. Barnes said he did not know the actual reason for this, but that was the way it was built, it had not been in operation when the trouble with hot gas outlet temperatures started, it was just a by-pass opened in the full open position. The cold water supply required to operate the thermo-relay in the outlet main to the condensers had not been installed.

Mr. A. H. Barrington congratulated Mr. Barnes on what must be the most amazing understatement in his paper—'There was some controversy over the resulting heat balance . . . .'

Mr. L. G. Townsend asked Mr. Barnes why he had used Bureau's method for working out the results. It would appear from the calculations that the method which proved that the condenser was short of surface area was Silver's method. He would suggest that possibly in the design of the condenser some confusion arose due to the figure taken for H_2. Mr. Townsend said this figure was important and made a difference to results. It varied widely with counter current, cross flow, etc. Mr. Townsend said that possibly in the design of the condenser cross flow figures were taken when they did not apply in this particular case, that would account for the fact that the condenser was deficient. Mr. Barnes replied that he could not say on what basis the flow was calculated on and could not really comment on it.

Mr. Woodcock said he would like to round off one or two of the questions. The atmospheric condensers at Leyland and Chorley were considered ideal for this job, even though they had been used as evaporation coolers. The wet and dry bulb temperatures of course came about because they specified a temperature of 175° at the inlet condensers; the temperatures obtained were above this, so naturally they were interested to see whether the gas was saturated or unsaturated. Obviously a few degrees higher on these temperatures meant an increase in the rate of condensation, and the point of saturation or not was very important. Apparently this question was raised and the figures had to be quoted in a hurry and were surprisingly correct. Regarding the temperatures at which one could shut down the carbonising plant, this depended on how badly you needed the gas and whether the plant was working at some fantastic temperatures. In fact, 90° was really nothing. The Arca valve was put in because the amount of make-up water required was small in the first instance and also the quantity variable. Secondly, to have any wide control of the gas temperatures it needed to be in the re-circulated water supply. Mr. Woodcock said he did not know which method was used by the contractors in their calculations for surface area, but he agreed with Mr. Townsend that the figure of heat transfer was important. He had wondered whether Bureau's method was used to calculate surface area.

From a paper to the East of Scotland Junior Gas Association, Dundee, January 11, 1958

Repairs to a 100,000 cu. ft. Holder at Keith

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UNTIL 1956, gas produced at Keith consisted of a mixture of horizontal and Tully gas, the latter being fed into the main gas stream at the exhauster inlet via a small relief holder. In an effort to reduce the manufacturing costs and if possible dispense with the use of steam completely, consideration was given at this time to the replacement of the Tully plant by a diluent producer. However, when a recording calorimeter was fitted considerable fluctuations in town gas quality were revealed, with the producer in use primarily due to lack of adequate mixing. The chief cause of this appeared to be that the town holder was operating with a single standpipe, the original outlet having been sealed off. All gas passing to or from the holder was via the original inlet main. Investigations into the reason for the outlet standpipe being out of use proved to be of considerable interest.

The holder is of 100,000 cu.ft. capacity, has a single lift and is spirally guided in a steel tank above ground level. It was purchased second-hand in 1924 and re-erected in the same year by Henry Balfour & Co., Ltd. Standpipes were 10 in. in diameter, secured by two stays each, and a total pressure of 5 in. was thrown. Its performance initially was entirely satisfactory.

An abnormal increase in the quantity of water collecting in the outlet syphon was first observed about 1938. To obviate regular pumping of this syphon a ¾ in. copper pipe was fitted to it at a point 2 in. below the level of the outlet main. This overflow was provided with a 'U' type seal which allowed the water to run as a continuous trickle to a suitable drain. As the volume of water continued to increase trouble was experienced in maintaining the holder water level due to a somewhat irregular and at periods inadequate town water supply. In view of this the pipe from the syphon was increased to 1 in. diameter and sealed in a tank 3 ft. by 3 ft. by 7 ft. deep sunk into the ground. A small electric pump was fitted beside the tank with a float control to recirculate the water to the holder tank. The small tank was provided with an overflow to a drain. This procedure continued until 1953.

It has been assumed that the cause of the excessive leakage of water was a drawn lead joint on the standpipe and, in view of this, during the foregoing period pellets comprising a wet mixture of sawdust, cement and fibrous material of varying kinds were regularly dropped into the holder tank in the region of the outlet standpipe. A surprising degree of success is reported, the flow being stopped for varying periods of up to a month.

As a precautionary measure at this stage a by-pass was fitted between the inlet and outlet holder mains and the wisdom of this became apparent early in 1955. The water leakage in February of that year exceeded the amount of water being carried from the syphon to the small collecting tank and partial flooding of the outlet main occurred. Only the availability of the by-pass prevented a possible cessation of supply. In view of this the outlet main was sealed off permanently and the by-pass brought into use.

This, then, was the situation in 1956, the imminence of official gas testing making it more than ever necessary that full use of the holder for mixing purposes should be available. In order to ascertain the current leakage, several tests were carried out on the water flowing from the standpipe and it was established that the leakage was at least 1,500 gal. per hour. Examination of available drawings showed the standpipe to have three lead joints. The lower length of pipe was leaded directly into a duckfoot bend bolted to the floor of the tank, while the upper joint was only 3 ft. 6 in. from the top of the standpipe which was shown supported by two stays. Consideration of these drawings gave further weight to the assumption that the trouble was caused by one of the caulked joints leaking with the tie rods holding the standpipe possibly displaced. The

holder water level was dropped 4 ft. with no improvement in water leakage, thus restricting the possible damage to the two lower joints.

At this stage the alternatives were:

(1) The carrying out of an underwater examination together with repairs if found possible. This operation could be tackled in one of two ways: (a) By taking the holder out of use, purging the crown and entering via the crown; or (b) by fixing a chamber to the tank side and gaining access to the holder tank below water level via this chamber. Operation of the holder could continue on a limited scale while this was being done.

(2) Taking the holder out of use for an extended period, emptying the tank of water and carrying out the necessary repairs before refilling.

An approach was made to Under Water Welders & Repairers Ltd., of Cardiff, who had experience of this type of work and a quotation was received covering the hire of equipment and men on a daily basis. The matter was discussed with the insurance engineer who advised against the use of a diver because of possible disturbance of the crown sheeting and because of doubts as to the usefulness of a diver on this type of repair. In view of this the second course of taking the holder out of commission and emptying was decided upon.

The only other storage available at Keith was the Tully relief holder. This was a single-lift holder, column guided in a cast iron tank below ground with a total capacity of 20,000 cu.ft. and throwing a pressure of 3.25 in. For several reasons this holder was not operated below two plates which gave an available storage of 12,000 to 15,000 cu.ft. In addition it was anticipated that four high pressure storage vessels in use at Banff would become available before this repair began. Despite the restricted alternative storage it was considered that, with careful control of gas makes, the town supply could be adequately maintained. Three beds of horizontal retorts would be required in conjunction with the diluent producer as compared with two beds of retorts and the intermittent use of the Tully plant previously employed. Duplicate man power would be required at periods of maximum output. It was now early winter, and, as the repair would have to be done at the period of lowest gas demand, the work was scheduled for May, 1957.

Meantime, however, considerable preparation was possible. As the Tully plant was to be replaced by the diluent producer, repairs to the producer were put in hand. These completed, the Tully plant was shut down, the Tully relief holder isolated by valving and the diluent producer brought into use.

Zinc Acetate Required

Steps were now possible to make the Tully relief holder ready for use on town gas supply. Records indicated that this holder had operated on crude Tully gas for over 50 years. Samples of the tank water were taken and calculations as to the quantity of zinc acetate required to remove all traces of hydrogen sulphide were made. In all, 16 cwt. of acetate was necessary to clean up the holder water. The treatment extended over two months, the acetate being dissolved in water and pumped into the lute at points all round by means of a stirrup pump. A small petrol driven pump was also employed to agitate the water and improve the distribution of the acetate solution. The process was extremely laborious but very effective. Stops were fitted to the holder columns and connections made from the inlet town holder pipe to inlet Tully holder pipe and also from the outlet Tully holder to link with the main supply to the town. A temporary 2-in. line was run from the Tully outlet main back to the inlet exhauster and by keeping this holder against the stops a continuous circulation of approximately 2,000 cu.ft. per hour was passed through the holder during the water treatment. A continuous hydrogen sulphide test bottle was fitted on this line giving an indication as to the progress of the treatment, which, as already stated, extended over a period of two months. Treatment of the water in the tank was considered most suitable as replacement of the water would have entailed its treatment in any case before passing via the drains to the river. To prevent undue strain on the holder columns when operating against the stops, 130 concrete blocks were placed round the periphery of the holder crown on wooden slats. These blocks gave the added advantage of increasing the pressure thrown by this holder to 5 in. W.G. when operating freely.

At this point the four high pressure storage vessels which had been in use at Banff became available, and provided a welcome addition to the Tully relief holder storage. These vessels were designed in conjunction with Stewarts & Lloyds Ltd., for use in such circumstances as these. They were fabricated from 36-in. nominal bore mild steel pipes with one end dished and welded, the other being flanged and fitted with a blank flange. The vessels were designed to operate at 100 to 150 p.s.i. and had been tested to 300 p.s.i. Compression was carried out by electrically operated twin compressors, 1-in. copper connections being used. Each vessel was fitted with a pressure gauge and safety relief valve set to open when the pressure exceeds 150 p.s.i., the gas then passing via a flame trap to atmosphere. An automatic cut off operates at 149 p.s.i. and switches off both compressors at the starters. Unless these starters are switched off compressors restart automatically when pressure falls to approximately 120 p.s.i. The compressors working together fill the four vessels in about 6½ hours and they can be emptied in less than an hour although, if this operation is carried out too quickly, trouble is experienced due to freezing up. The nominal capacity of each vessel is approximately 180 cu.ft. and, compressed to 150 p.s.i., approximately 2,000 cu.ft. releasable capacity. This unit was easily transported by road and was erected at a point adjacent to the Tully relief holder. The use of this additional storage allowed gas to be made at a more constant rate throughout the 24 hours, the vessels being filled generally overnight and emptied at periods of peak demand.

Deodorising the Water

It had been obvious that considerable difficulty would be experienced in the disposal of water from the town holder prior to the start of repairs, the capacity of the tank being about 700,000 gal. The water could only be disposed of by using an existing drain to the river and in view of the number of open drains in the town it was considered essential that the water should be completely deodorised. Previous tests had established that provided the flow of water from the holder was carefully regulated, no damage would be done to fish life. Several deodorants were tested and a mixture of coke and breeze found suitable. Two sectional tanks were erected, fitted with suitable weirs and filled with alternate layers of coke and breeze. The tanks worked alternately. In practice it was found that the water from these filters still smelt of gas and 1 cwt. of potassium permanganate was therefore added to the tank water before running off.

When all necessary arrangements had been made the holder was lowered as far as practicable and the inlet valve closed, the Tully relief holder now supplying the town. The inlet and outlet mains of the damaged holder were disconnected and the valves fitted with blank flanges with suitable connections on the inlet valve flange for the purging machine. A Harrison purging machine was employed using oil fuel, the inert gas being expelled from the crown in turn by air from the compressor. On completion of this operation the holder manholes were removed and the draining of the water commenced. This took a period of 26 days. An access hole was cut through the side of the holder tank and bell and a preliminary inspection made. As had been surmised, the outlet standpipe was tilted at a considerable angle, the lead from the bottom lead joint being forced completely clear of the joint at one point. This joint appeared to have been badly made, the lead being only about ¼ in. deep at one point. One of the two stays originally supporting the standpipe was found on the floor of the holder tank, although it is difficult to imagine how this could have become detached if securely fitted.

Both standpipes were completely dismantled and the bolts connecting the duckfoot bend to the holder floor removed. An improved method of securing the standpipe to the duckfoot bend was considered and an arrangement (shown in a figure to the paper) was finally decided upon. This entailed using a 24-in. flange of mild steel 1 in. thick, which was drilled and tapped to take the set screws securing the duckfoot bend from below and the set screws securing the 10-in. flanged socket from above. After all joints had been tightened, this flange was fillet welded to the holder base. The standpipes were completed using 10-in. cast iron pipe, as before, with lead joints, but as an added safeguard leak clamps were fitted on each joint. The standpipes were secured by three 24-ft. long stays of 3 in. by 3 in. by ⅜ in. angle iron secured to the

tank base by two pieces of angle iron welded to the base and bolted at the upper end to a clamp fitted round the standpipe. Three stays were considered the minimum necessary for the adequate support of these mains. With the holder out of commission the opportunity was taken to carry out other, less urgent, repairs which included the patching of the bottom row of side sheeting of the lift and replacement of the 10-in. inlet and outlet valves.

On completion of these repairs the standpipes were hydraulically tested for soundness, an internal inspection was carried out by the holder inspector, and the holder was passed as fit for use. Repairs had extended over a period of 41 days.

Consideration had already been given to the most suitable method of refilling the tank with water. Two courses were open:

(1) The use of normal town water supply which would only be allowed between specified hours with no guarantee of the amount available. It was estimated that refilling by this method might extend over a period of four or five weeks.

(2) To utilise the water from the nearby River Isla, which would involve pumping the water 400 yards.

Due to its speed the second course was agreed upon and the services of the local fire service were enlisted to supply pumps and other equipment and carry out this work. The refilling was completed in less than 48 hours at an overall cost of £250. In order to prevent bacteria entering the tank in the river water, 5 gal. of formalin were trickled in as pumping proceeded for sterilisation. Tests since filling showed the water to have a *p*H of only 6.5. Sodium hydroxide has been added to improve this and tests continue.

As soon as the tank had been refilled, the crown was again purged with inert gas and the inlet and outlet mains reconnected to their respective holder valves. These valves were then cracked to allow the gas purge of the standpipes and crown before filling the holder completely and once again bringing it into normal use.

SOME NOTES ON WEAR-RESISTING MATERIALS

Discussion on paper by Walter Jakeman published on p. 338, February 12.

Mr. J. K. Lord said there seemed to be a tendency to be conservative in the use of materials in the gas industry. We had had mild steel for a long time but other materials could offer very promising means of overcoming some of our difficulties. It would appear that if a job could be done in another material which would outlast by three or four times the job done in mild steel, we tended to wonder whether it was worth while trying a new material. On coke screening, Mr. Lord said it was not a question of the life of the dead plate on screening mats, in any material; it was not how many months' life but more particularly how many tons of coke went over it. He knew it was difficult to get all these figures but one should not be misled into thinking that a screen would last for ever even if nothing ever went over it.

On the question of glass for lining shutes, Mr. Lord asked whether it was a particular type of glass—armoured plate, case hardened, or with other special characteristics. The author stated that 'glass is naturally unsuited to coke under any conditions due to the roughness of the coke.' On what grounds was this statement made and had the author tried coke with glass? There appeared to be a possibility that armoured plate glass, or case hardened glass might stand up to coke quite well. Following on that, he asked the author's opinion about changing over and putting in glass dead plates on coke screens.

Mr. Jakeman replied that the glass used was ordinary ¾ in. plate glass, of no particular type. He felt that if coke went over it the glass would become scratched and very rough and would tend to impede the flow after a while. The effect would not show at first but as time went on the roughness would increase and begin to show. He did not recommend putting in armoured plate glass dead plates for the same reason given for the shutes. Case hardened or specially toughened glass might last better but he had not tried this. He agreed with Mr. Lord that there might be a possibility of experimenting with plate glass for use on coke screens.

Mr. A. H. Barrington said that the results seemed to be a little contradictory. On p. 9, table 2, of the paper, on a shute with a steep angle fitted, the results were indicated by grade 10. He assumed that on a steep angle of feed the glass would not stand up to the treatment. The glass was apparently much better on a shallow angle, being grade 1. It seemed odd that if the material was impinging on to the glass the wear would be less. On the steep angle there was obviously more abrasion and more likelihood of the material falling direct on to the steeper surface.

Mr. Barrington said he had used Mehanite at Stretford. This was a heat resisting cast iron. They had received a supply of it from a Stockport firm for producer charging door frames and purely as an experiment they had had wearing plates cast in this material. Countersunk bolt holes were cast in the plate because the plates were so hard. It was found that these cast iron plates stood up to the abrasion of coke better than anything else they had tried.

Mr. Jakeman referred to the steep angle of feed of glass, and said it had been found that for a steep angle feed the coal fell on to the glass and shattered it, and this was the reason why on the steep feed the result was shown as grade 10. They had not found Mehanite to be really better than other materials, at Denton. It had been subjected to the same treatment as the cast iron and wore away fairly quickly due to the rusting, although it lasted longer in the abrasive sense and that was why it was not as good as some of the other materials.

Mr. R. J. Bradshaw said he had had experience in the use of glass for screening, where it had been tried on vibratory skin cloths, but it only lasted hours against days for mild steel. The difficulty with the glass being that it was so hard it did not have any resistance to bombardment of hard substances like coke. Toughened or annealed glass ran the difficulty of being shattered by impingement of the coke, it only needed a sharp corner to strike through the toughened skin. This affected the high tension surface, which in turn affected the tension on the opposite side of the glass and caused it to fracture.

Mr. Bradshaw said one thing puzzled him—the author did not recommend stainless steel shutes, yet he recommended them for screening plants, and he asked why this was so and why the author had managed to get such long life on screening cloths. Mr. Jakeman replied that the reason for this was because at the point of impact it wore fairly quickly and caused slight hollows and caused the coke to run towards the sides and channels, which was not good because the flow should be distributed over the shutes and not just down the sides.

Mr. Lee asked Mr. Jakeman whether he thought case hardened glass tiles, after the style of Staffordshire blue splits, would be more successful than plate glass and did he think shattering would have the same effect and he wondered also whether Mr. Bradshaw had tried that type of material. He asked if the author had any experience at all with the use of shutes in which the material—either coal or coke—ran on itself that is, with a shute sufficiently steep enough with a right angle bend which would stand up and allow the material to build up and run on itself. He said that a short brick angle for short steep shutes was very successful.

Mr. Jakeman replied that one of the difficulties with glass was how to fix it into the shute. This was difficult with plate glass and he could not see how it was possible to fix tiles on glass. Mr. Lee stated this could be done with Ciment Fondu as with Staffordshire Blue splits. Mr. Jakeman said he had no experience with this, and with regard to the other point, he had not tried this at Denton where the shutes were

straightforward shutes. Mr. Lee said he felt it was a matter for deciding from the beginning.

Mr. R. J. Bradshaw said they had fitted the glass vibratory screen cloths quite simply. Providing the temperature was all right Bostik would hold glass on to anything. The difficulty was caused when hot coke passed over; it had a tendency to soften the Bostik. Adhesion stood longer than the glass which was eaten away by bombardment from the coke.

Mr. Nicholas said he was puzzled on the notes on wear-resisting materials, when in actual fact the author had done two things when substituting certain other materials for mild steel. He had prevented corrosion and broken down some of the abrasion resistance at the same time. He wondered if the author would be prepared to say how much wear had been saved. Taking, for example, aluminium buckets; he asked how much wear had been saved due to abrasion and how much due to corrosion and whether he had reached any conclusions in the case of the two barrows mentioned in the paper, one in stainless steel and the other in aluminium, as to which metal would be superior for this type of work. He also asked if the author had any idea why breeze and so forth did not stick in the bottom of the aluminium conveyor bucket and yet did in the bottom of the steel one.

Mr. Jakeman replied that he did not think it was possible to determine how much wear had been saved due to corrosion and how much due to abrasion. Once corrosion set in in stainless steel, it carried on, but with aluminium when that got a skin of oxide on the top this skin acted as a protective layer and stopped further corrosion, and that was one reason why aluminium buckets had lasted longer than stainless steel ones, because there was less corrosion. Corrosion in the main took place while buckets were idle, and if these were idle quite a long time a lot of corrosion took place in the stainless steel ones.

Mr. Jakeman said he imagined the reason coal did not stick in the buckets was that mild steel buckets would have a layer of rust and coal dust and the material would stick to this, whereas with aluminium the film is not of the same kind and did not offer any surface for the coal to adhere to so that it did not stick on the bottom.

Mr. L. G. Townsend asked if the author had experience of aluminium skips for handling coke; he had found these useful and successful in Liverpool. Mr. Townsend's second comment was on the use of barrows. He said surely if they had saved a weight of something like 2 cwt., the barrows should be filled to their original weight instead of reducing the quantity. This would seem to be the most logical way of showing a saving in money.

On the use of aluminium buckets for conveyors, Mr. Townsend said they had had a lot of success in Liverpool using non-metallic materials. They had used with success resin backed fibreglass for elevator buckets particularly—where corrosion was very severe. He wondered whether the author had any experience in this connection. On the lining of shutes Mr. Townsend said they had come across examples of abrasion which could be overcome by using rather harder materials—granite chippings embedded in cement fondu, and mixing very high proportions of granite in concrete, and found these successful in resisting abrasion, particularly when applied to curved surfaces and complicated bends where there was difficulty with dust catches, etc.

Mr. Jakeman replied that he had not had any dealings yet with aluminium skips, nor had he had any dealings with non-metallic buckets. The only ones he had tried had been pressed aluminium ones. He had not used high proportions of granite chippings, all he had used had been the tiles mentioned in the paper. Most of the Denton shutes were straightforward ones. As to whether or not these were successful, he had tried to show in the paper. Cast basalt was successful with all kinds of shutes. Lesco tiles had, without doubt, been successful in shallow tubes. Blue splits, if not quite as successful as Lesco tiles or basalt, had been successful in shutes generally. The ones he had tried and kept on had been successful; some were tried and had not been a success and had been discarded.

CALCULATING PRODUCER COKE CONSUMPTION

Discussion on paper by G. R. Scholes published on p. 339, February 12.

Mr. J. K. Lord thanked Mr. Scholes for a very ingenious and concisely presented paper. A lot of the information gained from the work and the method of carrying out the work was probably a little more than the quality and amount of coke used on producers. Possibly there were simpler ways of determining how much coke had been used on producers. The use of a waste heat boiler as a calorimeter was not sufficiently accurate for the purpose of the calculations, which had been based on the information gained from the waste heat boiler particularly, and the steam meter was not usually the most accurate of instruments. If the steam raised was wrong the rest of the calculations would be wrong, additional to this there were heat losses from the surface of the boiler. He said he felt sure the steam losses from the end plates were considerable. Mr. Scholes in reply agreed that steam meters were not all that accurate, but they provided sufficiently accurate results to determine the amount of coke used on the producers.

Mr. L. G. Townsend said he must first of all congratulate Mr. Scholes on being the first gentleman to present two papers for the F. Johnston prize. In congratulating him on the present paper, Mr. Townsend said much of what it contained took one's mind back to the mid-1928 period when, he believed, Dr. Hollings described the use of the waste heat boiler as a gas meter and, if he remembered correctly, claimed to obtain some quite good results by this method. Mr. Scholes mentioned in the paper the method for determining leakage, and Mr. Townsend wondered whether he could say he considered this particular method any better than the method solely based on air-free CO_2 content of the waste gases. He knew that involved doing a complete analysis of producer gas. For general purposes it was simpler and involved sampling several gases, but presented no difficulty. Great difficulty was experienced in determining the dewpoint of hot gases.

Mr. Townsend described a dewpoint meter suitable for ordinary works use which bore a resemblance to the sulphur apparatus. The instrument was of copper polished up; water was passed through it at gradually decreasing temperatures until the water was deposited on it. He said that the B.C.U.R.A. meter mentioned in the paper was a successful and very expensive piece of equipment far beyond the facilities of the normal laboratory of the Board. Mr. Scholes replied that he would not like to say whether the method was better. Spiers provided another method by which one could calculate and compare the two results.

Mr. A. H. Barrington said he would like to congratulate Mr. Scholes on his paper. It was very gratifying to know that some of the student apprentices were spending so much time in the retort house on the carbonising angle, and were sufficiently interested to produce a paper of this kind. Mr. Barrington said he had no questions to ask, but would just make general comments. He felt the final figure of 10.1 tons of coke used on producers was very nice to know. This fuel was subject to an error of $\pm 10\%$ due to heat losses from the outlet setting to the waste gas flue of the boiler itself. There were really two things; trouble in the retorts and coke consumptions in the producers. A lot of trouble was caused in the laboratory with CO_2 on airfree basis. He felt the best guide on some works was the amount of coke made for sale, which is what the Board were after eventually. He felt also that if the figure could be expressed over a period of months as coke available for sale with the normal moisture content, then any improvement in consumption of producer gas and any saving or reduction in the coke used on producers would show as an increase in the coke for sale, although this was, in a way, getting the answer round the back way.

GAS ON THE CONTINENT

German Built Coking Plant at Durgapur

58 HORIZONTAL CHAMBERS OF STILL DESIGN WILL CARBONISE 1,500 TONS OF COKE A DAY

AN article by G. Choulat in the November 22 issue of Das Gas-und Wasserfach describes the gas treatment plant associated with the 1,500 tons per day coking plant ordered for Durgapur in August, 1955. The plant is being built by the German firm, Carl Still, and consists of 58 horizontal chambers of Still design, each 14 ft. 9 in. high by 16 in. by 40 ft., complete with fully mechanised storage and handling.

Same Composition

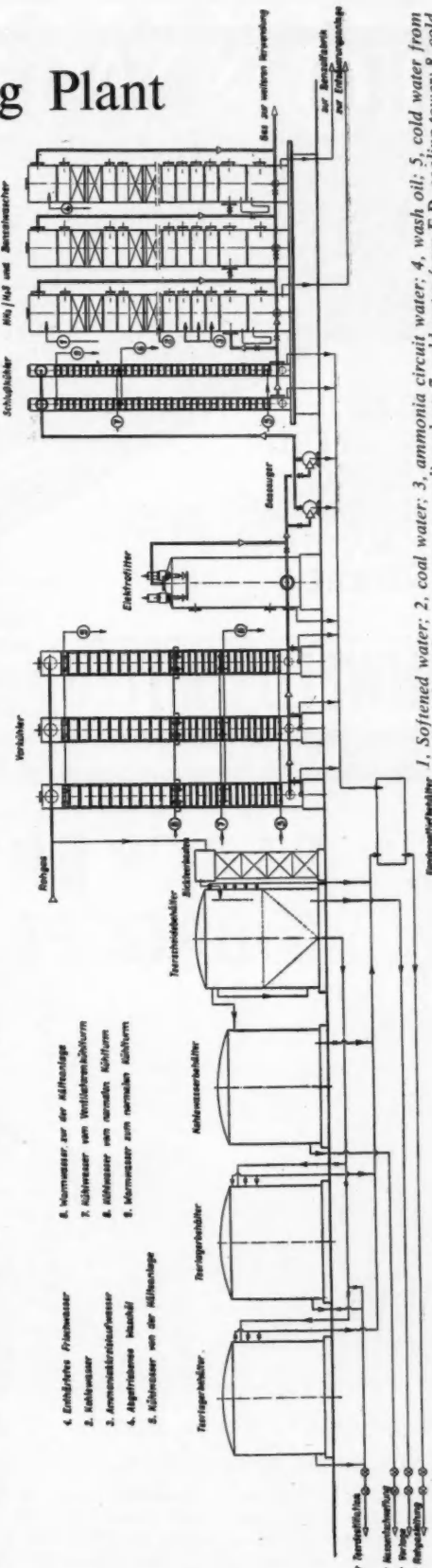
Before the gas reaches the plant shown in the diagram approximately 750 gal. of water are sprayed into it per ton of dry coal gasified. This serves to collect the tar in the high-level heavy tar tank from which it flows to the tar separator. The separator has a conical-shaped internal bottom and as the water separates, it flows out to the space outside the cone, thus keeping the cone hot and assisting the separation. The water is pumped in a closed circuit back to the spray point; any excess water condensed is sent to the ammonia or sulphur plant. The small quantity of heavy tar and dust collects in the heavy tar tank. The separated tar with 2-3% water is stored in the tar tanks. Condensate from the three primary condensers—each with a cooling surface of 14,600 sq.ft. and triple water circuits—in which the gas is cooled from about 81°C. to 20°C. together with condensate from the electro-static precipitators and pipe connections, is collected in the low level tank and added to the spray circuit. Thus all water drained off has the same composition.

The Washers

The gas passes through the exhausters to the two final condensers with a cooling surface area of 6,050 sq. ft. with twin water circuits to remove the heat of compression. The washers are combined expanded metal matrix and bubble tray columns. The expanded metal matrix with swirl trays has an efficiency approaching that of the bubble trays but with a much lower pressure loss, and so permits the washing operations to be done in a single column. The three washers, 130 ft. high by 6 ft. 9 in. diameter, are for ammonia and hydrogen sulphide removal, benzole removal with the third as a standby. No circulation of the washing water on individual trays is necessary with this design.

Lurgi Converter

Softened fresh water is added to the top of the tower; water freed from ammonia and H_2S in the ammonia and hydrogen sulphide plant is added half way down the expanded metal section, and cooled enriched washing water is fed back to the top four bubble trays. The enriched water is warmed by a heat exchanger and taken to the stripping column, which has a Raschig ring filling in the top half and bubble trays in the lower half. The water is freed of hydrogen sulphide and carbon dioxide in the normal way, and the hydrogen sulphide converted to sulphuric acid in a Lurgi converter. The ammonia is stripped in separate columns and cooled in condensers by the heat exchanger after which it is led to an ammonia treatment plant yet to be finalised. The benzole is washed out in the benzole washer with a simple wash oil circulation system.



1, Softened water; 2, coal water; 3, ammonia circuit water; 4, wash oil; 5, cold water from natural draft cooling tower. Zur Teerdistillation, to tar distillation; Zur Nassentschweflung, to wet sulphur removal plant; Zur cooling plant; 6, warm water to cooling plant; 7, cold water from F.D. cooling tower; 8, cold water from natural draft cooling tower; 9, warm water to natural draft cooling tower. Zur Teerdistillation, to tar distillation; Zur Nassentschweflung, to wet sulphur removal plant; Zur Vorlage, to inlet; Zur Rohgasleitung, to raw-gas pipe; Teerlagerbehälter, tar tank; Kohlewasserbehälter, coal water tank; Teerscheidebehälter, tar separator; Dickteerkasten, heavy tar tank; Kondensattiefbehälter, condensed water ground tank; Rohgas, crude gas; Vorkühler, primary condenser; Elektrofilter, electro-static precipitator; Gassauger, gas compressor; Schlusskühler, final condenser; NH_3/H_2S und Benzolwascher, ammonia/hydrogen sulphide and benzole washers; Gas zur weiteren Verwendug, gas for future use; Zur Benzolfabrik, to benzole plant; Zur Entsauerungsanlage, to acid removal plant.

G. Choulat. Das Gas-und Wasserfach. Vol. 98. No. 47. November 22, 1957. p. 1173. 6 pp. 5 ff.

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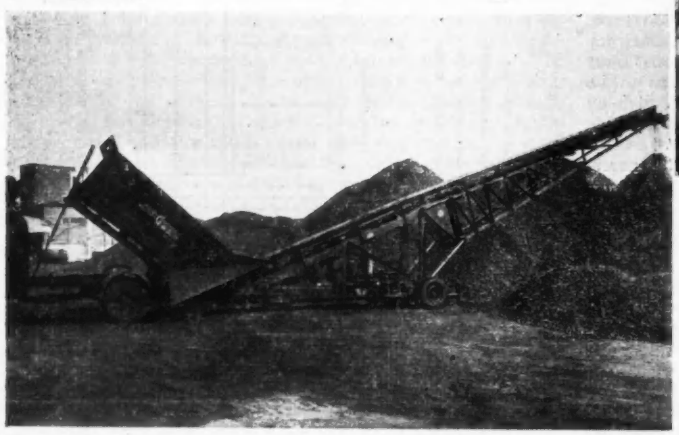

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